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DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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JULY, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 369, VOL. I.]

II. Undershot Wheels.

1. *On the ratio of Effect to Power.*—The experiments on undershot wheels were made with wheel No. I., and of course with centre buckets. The aperture was on a level with the tail-way, and the gate closing it was of the form *b*. (Fig. II. Plate IV. Vol. viii., Jour. Frank. Inst.) In the first set of experiments, there were air-vents in the soling of the wheel, through which the water, particularly at high heads, was forced violently, and wasted; and the series is accordingly omitted in the following table. This wasting of the water was from the inadequate size of the vents, as when half the soling of the wheel was removed it did not occur. The heads, apertures, and ratios of effect to power, occupy the successive columns of the table.

TABLE THIRTIETH.

Ratio of effect to power in the undershot wheel. Taken from tables S and T. (Vol. ix, Jour. Frank. Inst. p. 154–7.)

Table.	Head. Feet.	Aperture. Inches.	Ratio of effect to power.	Ratio for different heads.	Mean ratio.	Remarks.
S.	23.00	1.00	.294	.294		
"	20.75	0.75	.275			
"	"	1.00	.295	.285		
"	17.75	0.75	.287			
"	"	1.00	.292	.289		
"	4.67	1.75	.262			
"	"	2.00	.268			
"	"	2.25	.283	.271	.285	Half of soling removed.
T.	20.75	1.00	.296			
"	"	1.25	.300	.298		
"	4.67	1.75	.276			
"	"	2.50	.305	.290		
"	3.00	2.00	.277			
"	"	2.50	.272	.274	.287	Wheel removed from breast.
Mean ratio for high heads,					.292	
" " low "					.278	
Average,					.285	

The average ratio of effect to power appears from this table to be .285. The ratios for the higher heads are decidedly, though not considerably, greater than for lower ones, probably on account of the greater proportion which the effect lost by the water escaping between the wheel and tail-way bears to the whole effect, and which the width of the aperture bears to the head in low heads. All those heads in which the motion of the water was affected by the mode of supplying the forebay (see Plate I. Vol. vii.) have been excluded from the table.

Taking the average ratio of the undershot wheel for comparison with that of the overshot, we find a proportion of 2.98 to one in favour of the latter wheel, approaching nearly to the ratio of three to one.

While in the experiments of Smeaton the overshot wheel appears to have been underrated, the undershot coefficient agrees very nearly with that just deduced; hence our comparison is more advantageous to the overshot wheel than his, in the proportion of 2.98 to 2.

The ratio of effect to power being considered as constant, it follows that ***in a given undershot wheel the absolute effect is, under all heads, as the head of water.***

The virtual head wherever the flow of water is regular, is proportional to the real head; hence for a given form of gate, the rule which

is stated is general. When by varying the form we change the velocity of efflux, the effective head varies in the ratio of the square root of the velocity. In the case actually before us, the gate *b* is the one of the four forms used in different experiments which gave the greatest effective quantity of discharge.

It may be satisfactory to show that the head which would result from a calculation of the height due to the velocity of discharge, or virtual head, bore in these experiments a sensibly constant ratio to the real head, as has just been asserted.

The following table, containing the ratios of the observed velocities of the water, obtained from tables R, S, and T, (Jour. Frank. Inst. vol. ix, p. 154–7,) with the velocities calculated upon the heads above the aperture, will serve to show that these ratios vary within moderate limits, which are no doubt those within which the circumstances of the experiments may have varied without being detected.

TABLE THIRTY-FIRST.

Showing the ratio of the actual to the theoretical discharge under different heads. Gate b, undershot.

Table.	Head. Feet.	Ratio of actual to theoretical velocity.	Table.	Head. Feet.	Ratio of actual to theoretical velocity.	Table.	Head. Feet.	Ratio of actual to theoretical velocity.
R.	14.75	0.82	S.	23.00	0.79	T.	20.75	0.78
"	12.00	0.83	"	20.75	0.75	"	4.67	0.79
"	8.00	0.95	"	17.75	0.75	"	3.00	0.80
"	2.00	0.84	"	4.67	0.79	"	2.00	0.77
			"	2.00	0.78			

It is plain, from the manner in which these results vary, as well as from the amount of variation, that there is no sufficient ground to reject the actual heads in favour of heads calculated from the velocities of impulse.

The calculation of the effect by using the actual head, has, therefore, been preferred by the Committee, as more simple than the reference to a virtual head. An examination of table thirtieth will show that except in one case the ratio of effect to power is greater with a greater aperture. This does not arise from any difference in the actual velocity of the water compared with the velocity due to the head,

which might accidentally show some such relation. If the effects were corrected, by taking the virtual heads instead of the real heads, the ratio would rather be increased than diminished. It is necessary to recognise it as a true effect whatever may be its cause.

The truth of these remarks will be rendered more apparent by the following table, in which the actual heads and apertures are registered; the proportional discharges under the same head, but with varied apertures, are compared, and the effects as observed are also compared. Further to show that accidents in the velocity of discharge have not produced an apparent law, the virtual heads due to the velocities are calculated, and the ratios before obtained of effects are corrected according to these heads. A true comparison of effects under the same heads, but with different quantities of discharge, thence results.

TABLE THIRTY-SECOND.

Comparison of the relative effects under the same head, and with different quantities of water.

Table.	Head.	Aperture.	Ratio of quantities discharged.	Ratio of effects.	Virtual head.	Ratio of effects corrected by virtual head.
	Feet.	Inches.			Feet.	
S.	4.67	1.75	1.00	1.00	3.08	1.00
	"	2.00	1.20	1.23	3.00	1.27
	"	2.25	1.35	1.46	2.70	1.66
T.	20.75	1.00	1.00	1.00	12.69	1.00
	"	1.25	1.10	1.13	12.50	1.16
	4.67	1.75	1.00	1.00	3.13	1.00
	"	2.54	1.45	1.63	2.70	1.89
	3.00	2.00	1.00	1.00	1.88	1.00
	"	2.50	1.17	1.14	1.91	1.12

It will be observed in this table that only those experiments have been used in which the aperture was considerably varied. In the first set we have for an increase of 35 per cent. in the quantity of discharge, one of 66 per cent. in the absolute effect, and at a mean with an increase of quantity from 1 to 1.25; the effects increase from 1 to 1.42, or the increase of absolute effect is greater than that of quantity in the proportion of 1.11 to 1. We must admit, then, as a result of experiment, that an increase in the ratio of power to effect may be obtained by an increase in the quantity of water expended, at least under the circumstances in which the water was delivered to the wheel in these experiments. The physical cause of this effect is doubtless the same as that referred to in page 363, Vol. ii., new series, as producing a similar effect in the velocity of an overshot wheel.

By comparing the ratios of power and effect, corresponding to the table just given, it will be found that *when the quantity is increased at a mean twenty-five per cent., the ratio of effect to power is increased but two per cent.*

2. *On the relative velocity of the wheel and water for an undershot wheel.*—The ratio of the velocity of the wheel to that of the water has been deduced in the following table, taken from tables R, S, and T.

TABLE THIRTY-THIRD.

Showing the relative velocity of the wheel and water in an undershot wheel.

Table.	Head.	Velocity of water.	Velocity of wheel.	Ratio.
	Feet.	Feet.	Feet.	
R.	14.75	25.38	10.86	.428
	12.00	23.01	10·02	.435
	8.00	21.77	11.16	.512
	2.00	9.48	5.92	.624
S.	23.00	30.34	14.46	.477
	20.75	27.32	14.87	.545
	17.75	25.29	13.97	.552
	4.67	13.73	7.68	.560
	2.00	8.86	5.66	.639
T.	20.75	28.53	14.80	.518
	4.67	13.70	7.32	.534
	3.00	11.06	6.26	.565
	2.00	8.73	5.43	.622
			Mean,	.539

This table gives for the mean ratio very nearly what was before obtained in the overshot wheel.

The ratio of the velocity of the wheel to that of the water is nearly nine-sixteenths.

The relative velocities in Smeaton's experiments varied between the proportions of one-third and one-half. Oliver Evans gives nearly two-thirds as the result of his practice. It is worthy of remark that Waring's Theory of Undershot Wheels gives one-half for the relative velocities of the wheel and water.*

A close examination of this table would seem to warrant the inference that as the heads increase, the ratio of the velocity of the wheel to that of the water decreases. This, however, we apprehend is not a fair deduction. The results in relation to the velocity of the

*Am. Philos. Trans.—old series. Vol. iii, p. 147.

wheel seem by no means so regular as those relating to the proportion of effect to power; but in general it will be seen that where the aperture is increased with a given head, and only the low heads admitted of any considerable increase without throwing too much water against the wheel, the ratio of the velocity of the wheel to that of the water is usually increased. It also appears by the tables that only the larger apertures were used under the low heads, hence the experiments are not precisely comparable, a large aperture giving a greater velocity than a small one would have done. Sometimes the actual velocities of the water, (deduced from the quantities discharged) appear to have increased by an increase in the aperture; but in general the reverse is the case, as will be seen by the following table.

TABLE THIRTY-FOURTH.

Showing the velocity of the water with different apertures and under the same head.

Number.	Head.	Width of aperture.	Velocity of water.	Number.	Head.	Width of aperture.	Velocity of water.	Number.	Head.	Width of aperture.	Velocity of water.
	Feet.	Inches.	Feet.		Feet.	Inches.	Feet.		Feet.	Inches.	Feet.
1	20.75	0.75	25·50	5	4.67	1.75	14.08	10	4.67	1.75	14.21
2	"	1.00	29.14	6	"	2.00	13.41	11	2.50	2.50	13.20
3	17.75	0.75	24.39	7	"	2.25	13.07	12	3.00	2.00	11.01
4	"	1.00	29.19	8	20.75	1.00	28.69	13	"	2.50	11.12
				9	"	1.25	28.08				

In the first four experiments an increase of velocity attended an increase of opening, in the last two a very slight increase, and in all the others a decrease. As these irregularities run through the series, it would not be proper to base a law upon the mean result.

A comparison of the ratio which the actual discharge bore to the theoretical discharge, with different heads and openings, would not be more satisfactory. While it abundantly appears that an increase of quantity up to a certain point slightly increases the apparent velocity, there is not sufficient reason to deduce a law as to the increase of the latter element by an increase of the former; a conclusion entirely confirmed by general reasoning as to the effect produced by the physical cause to which these phenomena have been satisfactorily traced.

3. *On the effect of air vents in undershot wheels.*—At low heads

air vents are neither an advantage nor disadvantage, but when the water has considerable velocity they produce a waste, from the violent forcing of water through them with the escaping air. The result may be seen by the following tabular view from R, (vol. ix, p. 154,) in which the ratios diminish as the head increases, except in one instance, when the falling off was so rapid as to interrupt the flow.

TABLE THIRTY-FIFTH.

Centre buckets with air vents in an undershot wheel.

	Head.	Aperture.	Ratio of effect to power.
	Feet.	Inches.	
1	14.75	0.75	.273
2	12.00	1.00	.284
3	8.00	1.50	.266
4	2.00	2.00	.298

The mean ratio for the three higher heads is .274, which is less than the ratios for the higher heads in table twenty-third, in the proportion of 292 to 274, or of 1.07 to 1.

When a sufficient portion of the soling was removed to allow the free and gradual escape of the air, the water was not forced over the soling, even at high heads, and the ratios were raised at high heads, as may be seen in table thirtieth.

4. *On the effect of running an overshot wheel near to a breast.*— Wheel No. I. was in the first two series of experiments at the overshot aperture, retained in the place which it had occupied in the experiments upon the overshot and other apertures, that is, close to the breast. It was subsequently removed six inches from the breast, and a new set of trials made, under different heads.

A comparison of the results when running close to the breast, and when removed from it, is given in the following table, containing experiments from tables S and T, (Jour. Frank. Inst. vol. ix., p. 154–7.) made under the same heads.

TABLE THIRTY-SIXTH.

Comparison of the effect of an undershot wheel running close to a breast and removed from it. Tables S and T.

Head above the bottom of gate.	Head and fall.	Ratio of effect to power.	
Feet.	Feet.	With breast.	Without breast
20.75	20.75	.285	.298
4.67	4.67	.271	.290
2.00	2.00	.253	.281
	Mean,	.270	.290

The advantage in every case is in favour of the removal of the wheel from the breast, and at a mean in the ratio of 1.074 to 1.

[TO BE CONTINUED.]

Account of the Explosion of the Boilers of the Steamboat Henry Eckford. By THOMAS EWBANK.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN.—You have doubtless noticed the newspaper accounts of the explosion of the boilers of the tow-boat *Henry Eckford*, on the evening of the 27th ult., at one of the docks of this city. The following testimony was adduced before the inquest held the next day over the remains of the only person killed. His death is believed to have been caused by a mass of lead driven violently against his head. It formed part of the sheets upon which the exploded boilers were bedded, and was found lying near him. The Captain of the Eckford was wounded, but the engineer and firemen, though close to the boilers, escaped unhurt. All things considered, it is truly wonderful that more lives were not lost on the boat, the surrounding vessels, and on the docks.

Coroner's Inquest.—An inquest was held upon the body of Amos Belshow, late of Palermo, Oswego county, who was killed by the explosion of the boiler on board the tow-boat Henry Eckford, on Tuesday evening.

The first witness examined was Solomon S. Patchen, master of the canal boat Henry, to which the deceased belonged. The Henry was lying on Tuesday evening at the foot of Cedar street, and the Eckford came there to tow her round into the East river. Witness and deceased were making the Henry fast to the Eckford when the explosion took place; the Eckford had been letting off steam, and the

explosion occurred almost the moment the escape valve was shut. The body of the deceased was found on board the Henry.

Mr. Isaac Newton, one of the owners of the tow-boat, deposed that she was built in 1824—that she had a completely new boiler about six years ago—that last fall she was inspected and licensed by the United States Inspector, and that his certificate of her good order was on board—that the boilers were overhauled and stripped about a year ago.

Mr. Newton on his further examination stated, that the Eckford was 150 tons burthen, the engine was a compound engine, called "Wolf's Engine," twelve inch high pressure cylinder, and twenty-four inch low pressure, and condensed its own steam—the boilers about thirty inches diameter without return flues, about eighteen feet long—did not remember the thickness of the iron in the boilers. The safety valves were weighted at 150 lbs. for ten years previous to the boat having been used in the harbour, since that they have been reduced, and consequently the pressure reduced.

Mr. George House who has been in the employment of the proprietors of the line of tow-boats to which the Eckford belonged, as chief engineer, for ten or fifteen years past—deposed that he was for seven or eight years on board the Eckford as engineer—left her in 1834—considered her a safe boat then, and ever since—she never exploded before—she had new boilers in 1829 or 1830 made under the inspection of witness, at the request of the proprietors—the iron was thoroughly tested—the sheets used were all gauged—the sheets were plump quarter inch, called No. 1, which is the strongest boiler iron used.

Mr. House further deposed that the boilers were eleven and a half years old—have been frequently repaired since—has known similar boilers to wear fifteen years—did not see a certificate of inspection on board the Eckford since the last repairs.

Charles Maxton, the engineer, deposed that he had been employed on board the Eckford since the 25th of March last—that he had examined her machinery, and considered it perfectly competent for the business she was engaged in—that he did not, however, "consider her a safe boat for a heavy head of steam"—that he was on board the boat on the evening of the accident—superintended the getting up of the steam, which occupied about two hours and a half—the means by which he judged of the pressure, was by a weight hung on a lever—witness had examined the weight several times whilst the boat was lying at the dock—the boat had been lying at the dock about twenty minutes when the explosion took place—when the boiler burst, the pressure was about fifty pounds—witness considered that amount of pressure perfectly safe—witness also examined the water

and found it in his opinion sufficient—the explosion took place almost immediately after stopping letting off steam—at the time of the explosion, witness was standing by the engine room, having at that moment tried the water by the gauge cock—never heard any person interested in the boat express any fears of her safety.

Professor James Renwick was examined, and deposed that he was acquainted with the principle of "Wolf's steam engine," considered it as safe as any other—the risk depends upon the boiler—witness heard the testimony of the engineers, and so far as their management of the boat was concerned, did not think them chargeable with carelessness—ten years ago, English iron was regarded as the best for boilers—American iron is now considered superior—a boiler of the construction described by preceding witnesses would last a dozen years if carefully repaired—the cylinder form is the simplest and strongest—the flues are the weakest part of the boiler, and one made without return flues is safer than one with them—the diameter was within the size considered safe, being thirty inches. Witness thinks 150 lbs. to the inch beyond a safe limit, but does not think that a dangerous explosion would be likely to take place at 75 lbs.—considered 104 lbs. the maximum pressure that would be prudently employed—witness considered the boiler calculated from twenty-five to forty pounds the safest kind of boiler in use.

Mr. John Clarke, one of the steamboat inspectors appointed under the law of 1838, was next examined. He deposed that he, in conjunction with his associate, Elisha S. Bunker, inspected the Eckford three or four times—the last occasion was on the 1st of October, 1840—a certificate of her competency was then given—would have given her a certificate at that time as a safe vessel for conveying passengers—the law requires an inspection of steamboats once in every six months—intended inspecting the Eckford in a few days and went to look for her on last Saturday for that purpose—the law requires the inspector's certificate to be hung up in a conspicuous place on board the boats—was informed at the time of the inspection that the Eckford carries fifty or seventy-five pounds—considered that perfectly safe—the usual mode of inspecting the boiler of a steamboat is to examine it by looking through the furnace door—witness is a practical engineer—has been so for upwards of thirty years.

After the testimony has been gone through, the Coroner called the attention of the jury to the great importance of the case, and reminded them that the great object of the tedious investigation before them was to ascertain whether the steamboat was sea-worthy, and had all her machinery, boilers, &c., in perfect repair and order, and also if any blame was to be attached to the captain or engineer, or other

persons engaged in the management of the boat, for culpable negligence, or ignorance on their part.

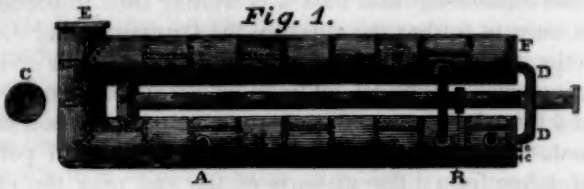
The jury returned the following verdict:—"The jury find that Amos Belshow came to his death by the accidental explosion of the boiler of the steamboat Henry Eckford, on the 27th of April inst. The jury believe that no blame can be attached to the owners, agents, captain, or engineers of the boat, it having fully appeared in evidence that said boat had recently undergone sufficient repairs—and the jury consider that if negligence is chargeable to any persons, it must be to the inspectors appointed by the Government of the United States, who had omitted to inspect the boat and engine, when duly notified by the agent of the owners that said boat was waiting their inspection."

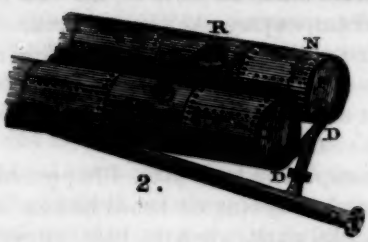
With a view to further the object of the Committee and thereby to subserve the interests of science and of humanity, I have endeavoured to procure such additional information as appeared necessary to understand the whole case. With permission of the person in charge of the boat, the engineer furnished me with three small portions of the boiler, taken from different parts of the end near the chimney; these, with the accompanying sketches and remarks, will enable the Committee to judge of the condition of the boilers, and to comprehend their construction and arrangement—and, with the preceding testimony, to arrive at a pretty correct conclusion respecting the cause of the disaster.

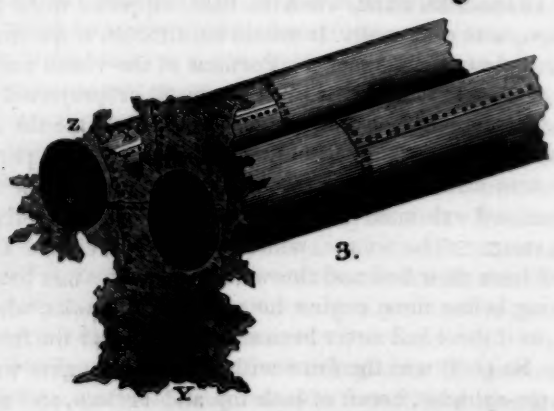
At the time the explosion took place I happened to be in the immediate vicinity, and hastening on board had an opportunity of observing its effects until dark, when the boat, supposed to be in a sinking condition, was removed. It would be difficult, if not impossible, adequately to describe the scene. Portions of the vessel and loads of fire wood that had been blown from her deck, or projected with the chimney and fragments of the engines and boilers into the air, were floating around. Nearly every thing but the heaviest parts of the machinery was swept off into the river, or upon the docks; while such as remained exhibited terrible proofs of the power that is developed in steam. The boilers, which probably weighed four tons, were raised from their bed and thrown nearly thirty feet towards the stern, bearing before them engine house, engine, cranks, wheels, and shafts, &c., as if these had never been secured to either the frame work or beams. So great was the force with which the engine was struck that the large cylinder, bereft of both top and bottom, and not a particle of either flanch remaining upon it, was hurled twenty feet further than the boilers themselves—while the massive cross-head, with the top of the cylinder, the piston and piston rod attached, were thrown several feet further. About two feet of the small cylinder with the

piston and rod within it was leaning against the end of one of the boilers. The cast-iron end of the starboard boiler (marked F in figs. 1 and 2,) was blown into the Captain's office near the stern of the boat, a distance of forty-six feet from its original position on the deck; and although two inches thick, was broken in two, both pieces were drawn out from among the bedding while I was present. But it was towards the bows of the vessel, where the most violent effects had taken place, and where nothing was left to indicate the force which had thus cleared all before it. It was here the chimney was located, (C in fig. 1,) but not a particle was left, the whole was blown into the air and then it fell into the river.

Fig. 1.







Nothing remained of the short cross boiler, (marked T in fig. 1) to which the ends of the two long ones were united, with the exception of such portions as are shown at fig. 3, and these were straightened out as represented.

The destruction of some, and the displacement of nearly all the machinery, rendered it difficult for a person not previously acquainted with the boat to detect (from the wreck before him) the mode by which the boilers were connected, or the arrangement for feeding them. It was not till the day after the explosion that I became aware of these and some other particulars. It is unnecessary to say any thing here respecting the engine, as its peculiarities are noticed in the testimony before the coroner. I may merely observe that the large cylinder was twenty-four and a half inches in diameter, and that both pistons had metallic packing.

The Henry Eckford had two wrought iron cylindrical boilers—see fig. 1, which represents their upper surfaces as seen from above, and as they appeared before the explosion. They were ranged fore and aft upon the middle of the deck—were nineteen feet long, thirty inches in diameter, and were placed eighteen inches apart. The furnace and fire door were towards the stern of the vessel, and the chimney C, was near the bows. The ends of the boilers over the fire were of cast iron, and connected at their lower parts by the feed pipe D D. R is the steam pipe with a branch and flanch at right angles, to which the one that led to the engine was connected. C C, the gauge cocks. The opposite ends of the boilers were united to a short one T. The larboard boiler L, being connected by a species of elbow joint, while the junction with the other was at the side, as represented. The open part of the short one being closed by a cast-iron end E. Besides being thus connected at their extremities, a passage from the interior of one boiler to that of the other, was formed below the water line, by a short pipe P, nine inches in diameter; and to the middle of this was joined another, O O, which was continued through the furnace and fuel beyond the fire door, where the feed pump was connected to it. This long tube was named *the heater;* its object being to heat the supply water before the latter entered the boilers. The front part of O O, passed through the furnace *below* the pipe D D, to which it was connected by a short vertical one, which I have endeavoured to represent at fig. 2.

There were two valves on the larboard boiler, A B fig. 1. The latter was one inch and three-quarters in diameter. The lever, weight, plug and rod were blown off and lost; nothing but the seat of the valve being left. The other one, A, was two and one-quarter inches in diameter, the distance between the centre of the fulcrum and that of the valve three and a half inches, and the lever four feet long; the weight is lost. As the upper edge of the lever had no notches or other graduated marks, and as the head of the valve rod had only a plain socket through which the lever was loosely slipped, it would

seem that the pressure of the steam could not have been very accurately ascertained, but must have been in a great degree guessed at. The small valve was close to the end of the boiler; it was formerly weighted to blow off at 150 lbs. on the inch, but at the time of the explosion, according to the engineer's account, at fifty pounds. It was named the tell-tale, and when steam escaped from it the other one was opened to let off the excess. It will be perceived that both the safety valves and gauge cocks were attached to the same boiler; no opening being in the starboard boiler S, except for the steam and feed pipes.

The present condition of the boilers may easily be stated. The part T, as already observed, was blown off, leaving the ends of L and S entirely open, with fragments hanging round them. These fragments show that the most part of T was greatly worn, and the texture of the metal deteriorated. Along the edge at Y (fig. 3) is was reduced from one-fourth of an inch, its original thickness, to one-twentieth of an inch, and even less in some places. The specimen No. 1 is from this part. No. 2, a piece that is only two and three-quarter inches in length, and not one and a half in width, exhibits the same or nearly the same extremes of thickness, and was taken from near the place marked X, while the largest specimen is from Z. The lines of separation are, in all instances, through the sheets, and not in the lines of the rivets; this circumstance may be accounted for from the fact that the heads of the rivets protected the metal over which they extended from corrosion, as seen in specimen No. 2, while the rest is, in most cases, worn to extreme thinness.

The end F of the starboard boiler carried with it a complete ring of the metal to which it was riveted, the line of separation being at N, fig. 2. At this place the metal is about its original thickness and appears to be little worse than new. To account for this part giving way, while so much stronger than others, the rupture may be supposed to have been effected on the same principle as that by which the barrel, or breech, of a musket is burst when heavily charged with powder, and the wadding not rammed home. On this supposition a rapid and excessive accumulation of steam must have taken place, and the circumstance of the end F having exploded favours such a conclusion, for had the vapour been gradually evolved, the numerous weak parts of both boilers, one would suppose, would have first given way, or at any rate that the part T would alone have been blown off. The uncertainty respecting the quantity of water in the boilers might also be adduced; for as the engineer tried the gauge cocks the moment after blowing off steam, we know that the foaming of the water consequent on the latter operation would render all *immediate* appeals to the gauge cocks useless—at such a time water would have been given

out had the cocks been placed on the *top* of the boiler. But it is not necessary to seek for the cause of this explosion any further than in the state of the boilers; they are completely worn out. Had the end F not been blown out, and thereby counteracted to some extent the effect of the rupture at T, both boilers would probably have been hurled to some distance from the boat. It is singular that no person was *scalded* with the hot water; neither the engineer, who was standing at the gauge cocks, and was knocked to one side of the boat, nor the fireman, who was partly in front of F, fig. 1, and carried, he knew not how, to the stern of the boat, received any injury. Nor was there any signs of water in the direction which the moving masses took. The end F was shot into the Captain's office, driving the front before it, but no water had followed, since every thing appeared dry when I saw it taken out.

The pipe P of very strong wrought iron, was entirely laid open, and O O, separated from it. The steam and feed pipes, R and D D, were broken and carried away. At H, fig. 1, there was a long rupture in the middle of a sheet, but it had obviously been caused by the sharp edge of some heavy machinery falling on the place. At the edge of the first sheet on the end of the boiler L, fig. 2, and on a level with the water line, is a small triangular hole through the metal, which I have tried to represent at J. Each side of this hole does not exceed three-quarters of an inch, and so far from its having been produced by a blow, it bears every sign of the piece displaced having been *corroded away*. The edges present no signs of fracture, and they are as thin almost as the thinnest specimens sent. Other very thin places have been detected by hammering in the same region.

THOMAS EWBANK.

New York, May 5, 1841.

Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. FRANCŒUR. *Translated by* W. H. EMORY, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 374, VOL. I.]

[Translated for the Journal of the Franklin Institute.]

19. *The Compass.*—This instrument is formed of a box, in the centre of which, supported on a point, is a steel needle, *n s*, (fig. 28. pl. II) rendered magnetic. It is a well known property of the magnetic needle that it takes a direction called the magnetic meridian, which is constant nearly for the same locality, and which does not vary much from that of a line running north and south.

The magnetic needle is a blade of steel, A B, (fig. 27,) long, slender, and pointed at the two ends. It receives the magnetic property by rubbing it with a magnet from one end to the other and always in the same direction. A cap of brass, or what is better, a cap of agate, is fitted in the needle, near its centre of gravity, which is scooped out in the shape of a cone, the apex of which rests on a very fine point, upon which the needle traverses with scarcely any friction, and is left free to present its two ends to opposite points in space.

If the needle before being magnetized is horizontal, or balanced when placed on the point, it afterwards takes a direction very much inclined to the horizon, and is brought back to a horizontal position by placing a piece of wax on the end which is uppermost.* Thus the process of magnetizing causes the needle when freely suspended to take a fixed direction, oblique to the horizon, and in the plane of the magnetic meridian. The inclination being overcome by applying a weight, the needle is left free in the horizontal motion, and takes a direction which at Paris is north-westerly and differs from the true meridian 22°. This direction changes with time and place, but for our purposes it is sufficient that it remains the same for many days together, in each locality. The northern and southern ends of the needle are called respectively the north and south poles. They are marked N and S, or sometimes to distinguish the northern end of the needle it is rendered blue by heat.

The power which determines the horizontal and vertical motion of the needle, seems to be the force of attraction exercised by large masses of iron in the interior of the terrestial globe, which by the known power of the loadstone to attract iron, forces the needle to take positions in the direction in which this power is exerted.

20. The compass represented in fig. 28, is a smooth square box containing a circle plated with silver, which is divided into three hundred and sixty degrees, and into half degrees. In the centre, and perpendicular to the plate, is a pivot of tempered steel, upon the point of which a magnetized needle, *n s*, turns freely upon its cap, so that the two ends of the needle pass very near the graduated circle without touching it, and enable the observer to read the graduation to which the needle corresponds.

The box is of wood, or of copper; iron is carefully excluded from it; and even the observer must not carry a key or any other article of this metal about him, by which the needle will be made to deviate from the magnetic meridian. The box is fastened together by dovetailing, or by brass screws. A glass fitted over the circle and held

* Copper wire is generally used in the United States as the counter weight for needles of the surveyor's compass.

in place by an elastic strip of brass, shelters the needle and plate from wind, and is sufficiently near without touching the needle when the compass is horizontal, to prevent it from being thrown off the pivot.

The needles are usually six inches long, and are a little raised at the ends, to give the oscillations more stability, at the same time it takes nothing essentially from the freedom of motion. The pivot is perpendicular to the limb and the bottom of the box, in which it is placed exactly in the centre. The last condition is ascertained by turning the box 180°, and if fulfiled, the points of the needle traverse the same track over the graduated circle.

Upon one of the sides of the box (fig. 15) is an alidade A B, movable upon an axis; this alidade has a motion about the axis in a vertical plane when the compass is horizontal; it is formed of a small hollow quadrangular tube, fitted tight against the side of the box and closed at each end by a metallic plate. Each of these plates is pierced with a small hole, and has a verticle tongue above, which takes the place of the thread in the ordinary alidade. Looking at an object through one of these holes, the opposite tongue should appear to coincide with the object. It is necessary that the axis of the alidade should be exactly parallel to the diameter of the circle marked zero and 180°. An axis fitted to the middle of the alidade enables it to revolve in a plane perpendicular to the circle of the compass.

A ball and socket is fixed under the box (fig. 13) and attached to it by a wooden plate with three arms. The two spurs, *a* and *b*, and the small bolt *c*, enter into holes under the box, and fix the plate there by means of the bolt *c*. Thus the compass can be made to take the horizontal position *a b c*, and turn freely upon the axis *i*. A clamp screw arrests the motion; and by the aid of a tangent screw, very delicate movements can be given. The instrument is leveled by means of spirit levels attached to the box, or by moving it until both ends of the needle, in an entire revolution of the box, escape contact with the glass cover and retain their position. This is an imperfect mode of leveling, but the degree of precision obtained by observations with this instrument does not require greater accuracy.

When the compass is not in use, the pivot is relieved from the weight of the needle, which is pressed against the glass, by the aid of a small lever, *il*, (fig. 28) one end of which is seen out of the box, and the other end *i*, carrying a ring in contact with the needle.

21. To explain the manner of using the compass in the measurement of angles, it is sufficient to remark that in every position which the box takes in turning on its axis, the magnetic needle preserves a constant direction, (the oscillations of the needle having ceased) as if fixed in space. If the needle reads 20° and 60° in any two positions,

the box and alidade in passing from one to the other has evidently traversed 40°, the difference between 20° and 60°.

Thus, in observing on two distant objects, after the oscillations of the needle have ceased, read each time on the limb the degrees marked by the same end of the needle; the difference of the arcs, passed over by the sight, reckoning from the magnetic meridian, measures the angle of two visual rays drawn from the station to these objects, reduced to the horizon. It would appear, then, that the compass can be used in the same manner as the graphometer in measuring angles and in plotting. It is, however, much less accurate. To lay down a section of country represented by fig. 24, the process is the same as that described in article No. 18.*

The determination of angles by means of the compass is far from correct; for besides the radius of the limb being small, and seldom reading nearer than to a quarter of a degree, the distance is so great from the graduated arc to the point of the needle, which is easily moved, that it is difficult to ascertain with accuracy the point of coincidence, or in other words, the given angle. The compass is indeed a very imperfect instrument, and is never used when exactness is required; but the use of it is so simple and expeditious that it is generally resorted to in all cases not requiring great precision. After staking signals on the angles of the outline, we proceed by the method of making the circuit, which consists in chaining entirely around the polygon to be surveyed, and measuring all the angles. Place signals at the points A E D C B, (fig. 29;) from A, direct the instrument to E, and read the angle passed over by the instrument from its direction A B, and measure the distance A E; then from E, direct the instrument to D, read the angle measured, and chain the distance E D, and so on around the entire figure, (see No. 26.)

We thus have all the sides and all the angles of the polygon, from which it is easy to plot it on paper; if the work does not close, or in other words, if the last line B A does not fall so as to join E A at the point A, which is usually the case in surveys, made even with this imperfect instrument, we can judge of the extent of the error and make approximate corrections. If any object is remarked, when going round, desirable to be placed on the plot, its position is determined, without the necessity of approaching it, by the method of intersections (explained No. 18.*)

It is unnecessary, when the compass is used in running courses, that all the signals be seen at the same time; it is sufficient that one alone be visible; for this reason it is the most convenient instrument for

* See page 373, vol. I, 3rd series, on the use of the Graphometer, which should have been numbered 18.

laying down the courses of a river, the roads of a forest, &c. After placing signals at the principal bends A, B, C, D, &c., (fig. 30,) start at A and direct the instrument on B, then from B direct it on C, from C on the signal D, and so on; read each time the angle made with the magnetic meridian, and measure all the distances A B, B C, C D, &c. The portion of the polygon A B C D can then be constructed as heretofore.

It is not necessary, in the method of making the circuit, to make subtractions to determine the angles A B C, B C D, ... ; as the magnetic needle always takes a constant direction represented by the parallels, A N, B N, C N, ..., traced on the plan, and it is sufficient to construct with the protractor the angles N A B, N B C, N C D, ... which are the same in fact as those read from the compass.

The use of the protractor can be avoided by fixing the sheet of drawing paper, which is to receive the plot, firmly on the table, and placing the box on the paper and turning it until the needle takes the directions successively observed at the different stations. In these positions the box is made to take positions parallel to those at the stations, and the lines drawn with a pencil along the edge, which serves as a rule, are right lines parallel to the visual rays seen through the alidade. To facilitate this operation, the alidade, which is only fixed to the box by a screw which answers as an axis, is removed.

22. Some improvements have been made in the compass. A small telescope is used in place of the alidade, furnished with cross hairs at the focus of the object glass, as described in article 8. One of the hairs should be so placed as to describe a plane parallel to the principal diameter (zero and 180°.) On the outside of the tube, sights are attached. The telescope is used for objects at a great distance, (see fig. 28.)

A small graduated arc of copper is attached to the telescope by means of which the position of the telescope with relation to the horizon is given; so that besides the horizontal angle included between signals, the angular height may be obtained, that is to say, the angle made with the horizon by a visual ray to the signal, (No. 46.)

To place the instrument quickly in adjustment, the universal joint represented in fig. 13, is used; for slight movements, a tangent screw is fitted to the box.

23. *The Plane Table.*—This is another instrument used for projecting plans; it requires scarcely any knowledge of geometry, and is very easy to use. It consists principally of a small rectangular board, 22 by 30 inches on the sides, which can be fixed horizontally on a set of legs. A sheet of paper is stretched on the surface to receive a plot of the work as the successive observations are made. The plane table with its legs, can be carried from place to place, (see fig. 19.)

It is composed of a stand with three legs, surmounted by Cugnot's joint, (No. 13,) by which the table is made horizontal. A spirit level is attached to the table, to indicate if it is horizontal; this may be ascertained also by placing a billiard ball on the table, and if it is horizontal, the ball will remain in repose in any position it is placed.

As a sheet of paper 22 by 30 inches would not, in most cases, be large enough to receive the plot, and as it would be difficult to change the paper, a number of sheets are pasted together and rolled on two parallel cylinders placed under the side edges of the plane table, which are movable about their axes. Each cylinder, or roller, carries a cog wheel, with a click which prevents them turning but in one direction. When necessary to extend the operation of plotting farther, the click is disengaged, the paper unrolled from one of the cylinders and rolled on to the other. For this purpose a key is applied to the axis of the cylinder, which is made square and to project beyond the end. The paper is thus always kept stretched on the table, and is strengthened by being pasted on muslin or silk. To avoid confusion, the rollers are not represented in fig. 19.

The table P P is fastened by four clamp screws, *v v*, to another and smaller table, *p p*, which last is fastened solidly to the joint, and by means of the central axis E turns upon a horizontal disk, *c c*.*

P P, fig. 19, is the table which carries the plot stretched upon it; *p p* is the second table upon which the first is fixed by four screws, *v v*, at the angles; *c c* is the disk or circular plate fixed at the joint N. The pivot is a large bolt through the centre, the lower end of which terminates in a screw V, with a milled head; after passing through the disk this bolt passes between the lateral bars L L, of the joint. To clamp the table the screw is tightened.

In place of Cugnot's joint, the ball and socket (Figs. 13 and 22) which is lighter and less costly, can be used. There is the disadvantage, however, that it is more difficult to level with, and the table when leveled is disturbed by the slightest pressure.

It is frequently necessary to give a small motion of translation to the upper table; this is done by means of a tangent screw R, which is attached below *c c*. The starting point of the plot should be in a vertical line directly above the corresponding point on the ground. With the aid of a plumb line, or a pebble dropped from under the table, this position is soon obtained.

*The manner of connecting the plane table with the tripod has been much improved upon in the instruments of recent construction. The improvements consist chiefly in dispensing with the small table *p p*; the adaptation of screws for the purpose of leveling the table, and a contrivance by which the tangent screw can be thrown in or out of play.

24. There are three ways of using the plane table, which are combined together according to the nature of the cases which present themselves. The alidade represented in Figs. 10 and 18, is used for sighting. The end of the dividers, or a needle, is placed at the point on the table, which represents in the plot the place on the ground occupied by the instrument. When directed towards a signal to be projected on the plot, the edge of the alidade is placed against this needle, which serves as a pivot and point of support. A line drawn with a pencil along the edge of the alidade, will be the horizontal projection of the visual ray from the station to the signal.

Before explaining the three methods above referred to, we will explain the method of projecting a triangle, R S P, (Fig. 25.) Fix the plane table at R and level it, then direct the alidade to the points S and P, and draw in their respective directions, with a pencil, the indefinite right lines *rp*, *rs*. This done, remove the plane table to S, and measure the distance RS; then take from the scale which is adopted for the plot, the distance *rs*, equal to as many parts as there are units, &c. of measure in the distance RS, and the point *s* on the plot will correspond to the point S on the ground. Arrived at station S, place the plane table so that the line *sr*, already traced, shall be in the direction SR, and the point *s* on the paper be vertically over S. The alidade when placed on this line should have its sights directed on the signal R. From this position turn the alidade about the point *s*, until the third point P, is brought in the line of the sights. Draw the indefinite line *s p* P, and the point where it intersects *r p* is the projection of P. Thus *s p r* is the horizontal projection of S P R.

With the aid of a protractor and dividers, the dimensions of the angles S, R, P, and the length of the sides S P, R P can be deduced from the figure *spr;* from which we see that angles and distances which are inaccessible, can be measured by means of the plane table.

This being well understood, let us explain the three methods of plotting with this instrument.

25. The first is the *method of intersections*, explained page 373, vol. I. The base A E, (Fig. 24) is measured with a chain, and the plane table is established successively at the two extremities A, E.

A right line *a e*, is traced on the paper, equal in distance to A E when reduced to the scale of the drawing. When the plane table is placed at A, it must be leveled, and the point *a* placed immediately over it, as heretofore explained, and the line *ae* must be in the direction AE.

The alidade is then directed to the signals B, C, D ...., successively, by placing its edge againt the needle fixed at the point *a*, and turning the alidade around it. As the different positions are taken, the

lines *ab*, *ac*, *ad* . . . . ., corresponding with AB, AC, AD . . . . ., are drawn. Thus a series of lines is obtained diverging from *a*, upon the prolongation of which is found the plot of the signals B, C, D, &c.

The instrument is then removed to station E, and is adjusted horizontally so that the point *e* shall be exactly over it, and the line *ea* in the direction EA. This done the same operation performed at A is repeated at E, that is to say the line *ed*, *ec*, *eb*, &c. diverging from the point *e* are drawn, corresponding to the directions ED, EC, EB . . . . ., respectively. These lines intersect the first at the points *d*, *c*, *b*, &c., which are the representations on the plot of the signal D, C, B, &c. To avoid confusion and errors in the intersections, write along the lines drawn from A and E something to distinguish the particular signal each line corresponds with. After the lines are traced, angles and distances can be ascertained without actually measuring them.

26. The method of *making the circuit*, alluded to in Nos. 18 and 21, is longer but more exact. To plot the polygon (fig. 20) a station is made at every angle. Beginning at A, the plane table is established according to rules already given. The alidade is turned towards E and a line traced on the paper in that direction. The distance A E is measured and laid down on the line *ae* just drawn, by means of the scale, and the point *e* on the paper represents E on the ground. Then remove the instrument to E and adjust it by placing *e* over E, and the line *ea* upon EA; fixing the plane table in this position, move the alidade alone by turning it around *e*, and trace the indefinite line which coincides with E B. The distance EB is measured as before and laid down on the plot in the line *eb*. Thus we proceed from angle to angle until the whole circuit of the polygon is made. On getting back to the station A, the polygon closes exactly if the work is correct.

This method is the one usually practiced to take the contour of woods, the sinuosities of roads and streams, and whenever from any one of the stations but few of those adjacent can be seen.

27. The third process consists in establishing the plane table at only one station C, (fig. 26.) This station is generally chosen in the interior of the figure to be plotted, and at such a point that all the other signals can be seen from it. The alidade is directed successively in the directions CA, CB, CD . . . . ., and the lines C*a*, C*b*, C*d* . . . . . traced on the paper with a pencil. This done, all the distances CA, CB, CD . . . . ., are measured with the chain and put down on the paper by means of the scale, and the points *a*, *b*, *d*, analogous to A, B, D, are thus determined.

28. With the aid of a declinator, the time required in adjusting the plane table in reference to its bearings, is much abridged. The declinator is a small compass comprised in a long rectangular box, with

the needle having a play of about forty degrees. After the plane table is fixed at the first station as heretofore explained, place the declinator on the table and turn the box until the needle takes the position of zero, then draw a line along the side of the box. When the table is transferred to another station its proper position is given to it by placing the side of the box on this same line, and turning the table until the needle is on the zero point of the graduation. The table is then fixed in the position required for performing the necessary operations, and is the same, or nearly so, as that which would have been obtained by allining the instrument on the preceding station.

29. The explanation given above of the construction and use of some of the instruments used in topography, is sufficient to show the manner of tracing the plan of a city, district of country, park, forest, or any other locality not very extensive. There are many other instruments designed for the same purpose, but they are intended for special cases, and enough has been said to form an idea of the use of them.

Peculiarities sometimes present themselves in the field, which the preceding methods do not provide for, requiring the resolution of triangles to obtain the position of a signal on a plot. An explanation of the means then resorted to is the subject of the following chapter.

[TO BE CONTINUED.]

Description of a Plan for Curving Railroad Bars. By ALFRED C. JONES, Engineer.

TO THE COMMITTEE ON PUBLICATION.

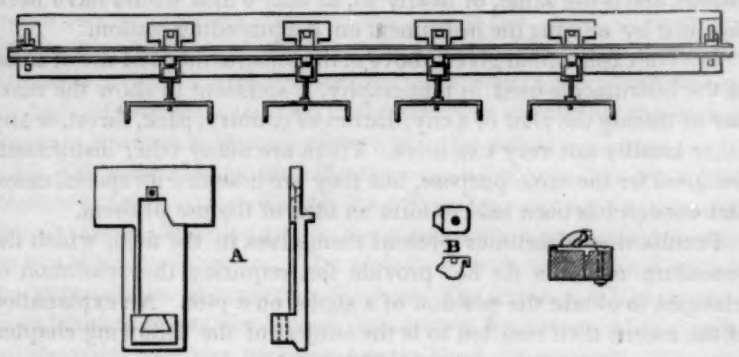
GENTLEMEN.—In connexion with the report on the New York and Erie Railroad, I hereby submit a plan for curving railroad bars; devised by me while engaged on that road.

On all well made railroads, the bars should conform to the curves; this in most cases has been done by springing the bar, and spiking it to its place. This is an imperfect method, for in a short time the running of the cars, assisted by the tendency of the bars to return to a straight line, causes them to become chords, and thereby lessens the smoothness of running and increases the wear and tear. This being understood, I was directed by the engineer of the road to curve the bars previous to laying them.

The methods usually practised for that purpose I discarded, as being too slow in their operation for a due observance of economy; and having often experienced the good effects of the screw as applied to similar purposes, I devised the arrangement as figured. As it will be easily understood, a description of the individual parts is unneces-

sary further than to say that the heads are of cast-iron, (A, one enlarged) the screws of wrought iron, one and an eighth inch in diameter, and a number six thread, the end of the screw being reduced so as to enter a countersunk hole in the back of the follower B, to keep it steady.

The backing heads are seventeen feet six inches apart, and the four others placed at equal distances between them. All being bolted to a hemlock bench, seventeen feet six inches long, eighteen inches wide, and eight inches deep.



Mode of Operation.—The bar being placed with its base on the bench, the two end followers are slipped in, and their screws turned to a certain extent; the two middle ones are then run up and the bar forced to a greater distance; this releases the two end screws, which are unscrewed and the followers removed; the two middle ones are then released, and the bar marked on its inner side with a stroke of paint for each eighth of an inch (versed sine) of the curve, this also shows the concave side of the bar, and saves time in sorting for laying. The distance to which a bar is sprung in the machine is usually five inches, this gives a permanent set of about half an inch; the bars are marked with one eighth less than what they stand at, thus ⅜ inch |||, meaning three eighths; this is to compensate for a partial straightening of the bar, and it is also better in laying, to decrease than increase the curve.

I will remark that the elasticity differing in bars, the distance to which they should be sprung will depend on the judgment of the operator, some requiring but two inches and others more than five, to retain a permanent set of half an inch.

This machine being in operation only during the most inclement part of the last winter; I am not prepared to say what is the maximum number of bars which can be curved in a day, but with active hands they may be curved as fast as brought to the machine; four hundred have

been curved in a day by two persons attending the screws. The T shape form of the castings is to admit of a larger surface for the outer web to be hammered on when bars are wanted to be adapted to a small curve for temporary tracks. Blocks of wood being interposed between the follower and the bar, it can be forced to any extent; this supercedes the necessity of having the screws made long, which would be an objection in the ordinary working of the machine. For the dimension and form of the bars see the report.

Ventilation of Subterranean Works, illustrated by practice at the Pawpaw Tunnel on the Chesapeake and Ohio Canal. By Ellwood Morris, Civil Engineer.

Ventilation, whether of buildings or mines, is usually a mere result of the laws of gravity, produced by a disturbance, either natural or artificial, in the equilibrium of the atmosphere at the spot ventilated; whereby a pneumatic current is formed which displaces the foul by fresh air.

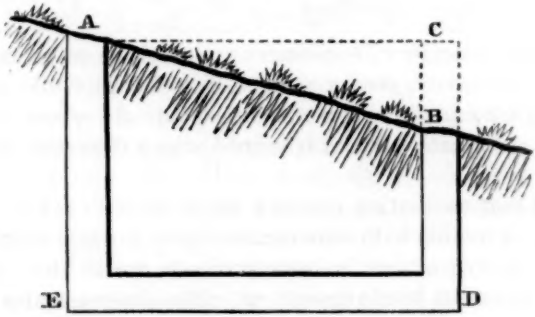
It is true that ventilating currents are sometimes produced by setting the air in motion with blowing machines; but this mode of ventilation is so rarely practised in subterraneous works that we do not propose to discuss it here; though we may observe that it is merely one of the means of disturbing the atmospheric balance, and bringing the gravitation of fluids into action to create ventilation.

The whole theory of the ventilation of mines is very beautifully and briefly laid down by professor Olmsted in his treatise upon Natural Philosophy, (see vol. ii.)

In the most general terms *ventilation* consists simply in *continually destroying the equilibrium of the atmosphere at the spot we desire to ventilate*, the attraction of gravitation being then brought into play, fresh air moves instantly to restore the disturbed balance, the pneumatic current which produces ventilation is promptly formed and all that we have to do is to arrange our means so as continually to destroy the equilibrium as fast as it is restored, and leave the rest to the operation of the fixed laws which govern the gravitation of fluids.

This result it is generally easy to attain by so planning our works as to bring to our aid some of the immutable laws of nature herself; thus in the case explained by Professor Olmsted, which, as we have before stated, comprises the *fundamental principle* of ventilating mines, though it admits of being acted on in numberless ways by varying our arrangements to suit the particular locality.—Let A E and B D be two shafts, sunk the same depth, E D, (we quote the substance from memory not having the book at hand,) it is manifest that until

joined by the drift E D, the air in both will remain quiescent; but suppose the drift E D to be completed, then during the *summer* the longer column of air A E, being cooled by the surrounding earth, would inevitably preponderate over the shorter column of cold air B D, because the density and of course the weight of the cool column A E, would be greater than that of the compound column of the same height C D, for the portion C B being formed of the summer atmosphere would be warmer and lighter than the air either in B D or A E, both of which would be cooled by the earth, consequently a current of air would continually descend A E, pass along the junction drift E D, and finally rise out of D B.



In the *winter* the reverse of this would take place, and the ventilating current would then descend B D, (for the compound column would at that season be heavier) and passing from D to E ascend E A; and this train of reasoning will hold good by inversion, even in those shafts of vast depths, where the heat of the earth's nucleus would enter as an important element into the disquisition.

Such is the simple principle which produces the perfect ventilation of the most complicated mine; it is only necessary that there should be a single, and but a single, continuous passage to conduct the air to every part of the mine, the beginning and the end of this passage must both be above the surface of the earth, they may be near together or far apart; they may even be at the same level, though the ventilation will be more brisk in proportion as their elevation differs, and though the continuous passage may curve or recurve in its course, no connexion must be opened from one part to another, unless by doors properly constructed to prolong or shorten the distance ventilated, as is often practised in extensive coal workings: in fact every mine must be regarded as one or more syphons inverted, any two communicating air shafts forming the legs of which the apertures are above ground, and we may curve or contort the intermediate part as

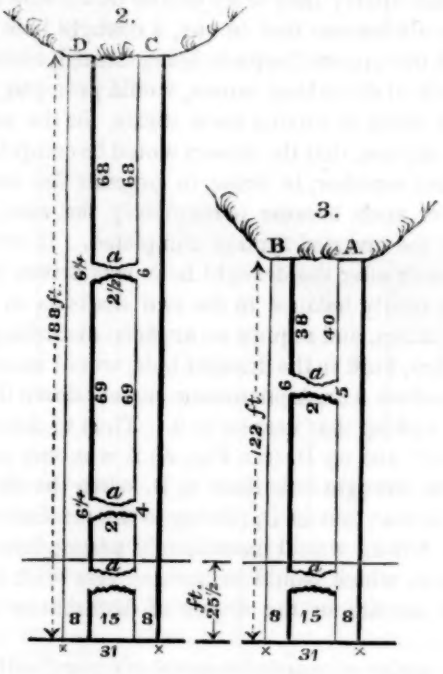
we please, it will in principle remain an inverted syphon still; all that is necessary then to ventilation, is to destroy the equilibrium of the air in this syphon, by diminishing its density in one of the legs, or increasing it in the other, when the pneumatic draught will instantly begin, and continue until the disturbing cause ceases to act.

In sinking the working shafts of the Chesapeake and Ohio Canal Tunnel, they were sunk in pairs, each being eight feet in diameter and fifteen feet clear apart; they were driven down side by side, so that whenever the air became foul in one, a draught hole could be cut to the other, and the inverted syphon being formed, ventilation, induced by the presence of disturbing causes, would promptly begin. It was no uncommon thing in sinking these shafts, for the air at the bottom to become so impure, that the miners would be compelled to stick two or three candles together, in order to procure the ordinary light of one; whenever such became permanently the case, draught holes were cut, and the inverted syphon completed. It would sometimes happen that even after the draught hole was driven through, the air would still so nearly balance in the two shafts as to produce a too sluggish ventilation, and require an artificial disturbing force; in such cases a small fire, built in the draught hole, would immediately accelerate it, and produce a brisk pneumatic current down the shaft furthest from the fire, and up that nearest to it. Thus to determine a flow of air down shaft C and up D, (see Fig. 2,) it was only necessary to kindle a fire in the draught hole close to D, when the air in shaft C, becoming heavier than that in D, (owing to the rarefaction produced by the fire in the latter,) would immediately preponderate, and cause a current to ensue, which would be more or less brisk in proportion to the activity of the fire, or the degree of disturbance of equilibrium produced.

It was only under occasional atmospheric peculiarities that the use of fire became necessary, for although the tops of each pair of shafts were upon the same level, disturbing forces of some sort were usually present; thus—a difference of the number, or animal heat, of the men working in each shaft—an unequal number of buckets of water, or soil, hoisted out—a greater frequency of blasts in one than the other—superior coolness produced by a greater evaporation from the dripping sides of one—and other causes, apparently insignificant, would almost always create a difference in the temperature, and of course in the density of the atmosphere within the respective shafts, sufficient to excite a ventilating circulation; indeed, though frequently down in the shafts, the writer never recollects descending without witnessing a perceptible current of air, which was sometimes quite strong without the presence of fire.

Fig. 2 exhibits a vertical section of shafts C and D, 188 feet deep, showing the number of draught holes *a*, it became necessary to cut preparatory to working the heading.

Fig. 3 exhibits similar information respecting shafts A and B, 122 feet deep.



All the shafts were sunk upon the centre line of the work, and being completed, the heading workings were commenced as soon as the water sumphs at the feet of the shafts were sunk and finished. These workings were prosecuted without any other means of ventilation becoming necessary than an occasional fire at the foot of the shaft. In very damp weather the gunpowder smoke would sometimes hang heavily in the workings, and produce the most intense darkness; but the atmosphere at the working breasts never became oppressive to the lungs.

The following vertical section (Fig. 4,) shows the length to which the above system of ventilation was carried in the tunnel referred to;

it presents the state of the workings, and the distance of the respective headings from the shafts or portals at the time the workings were united or driven out—immediately previous to which, the writer can state from personal inspection, that no unpleasant effect upon the organs of respiration was perceptible in any part of the headings, and consequently the limit of ventilation was not reached in these tunnel workings.

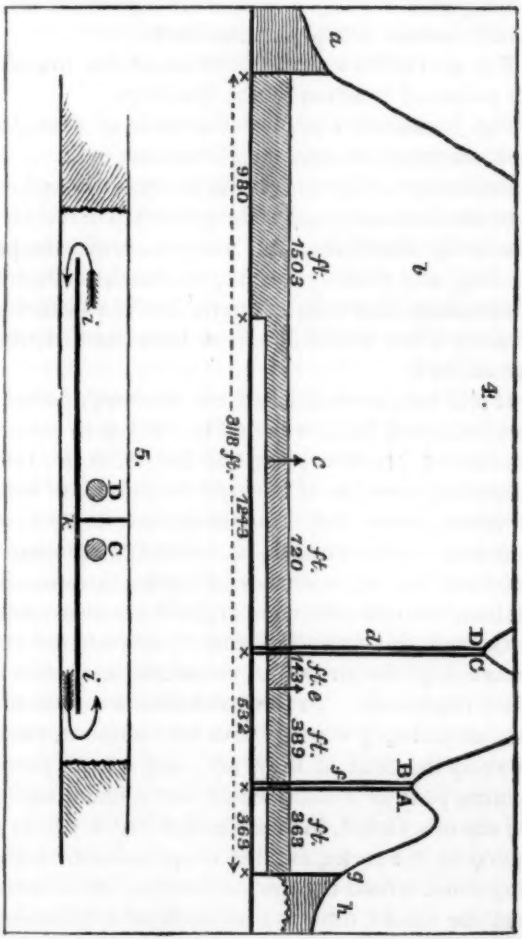


FIGURE 4.

a South Portal.
b Blue Slate Rock.
c Headings united June, 1840, at 340 feet under ground.
d Shafts 188 feet deep.
e Headings united June, 1839, at 230 feet under ground.
f Shafts 122 feet deep.
g h Driven out April, 1839.
h North Portal.

FIGURE 5.

i i Air-tight Partition.
k Horizontal Section.

Indeed we entertain but little doubt that inasmuch as the material wrought engenders no deleterious gas, we might, by bringing fully into action, through the use of air-tight partitions, the principle of the inverted syphon, have proceeded safely with the heading at least a quarter of a mile from the feet of the working shafts.

Fig. 5 exhibits a plan of the partitioning which would have been put in had the air become foul in the workings, and by air-tight partitions upon this plan, or some other device operating upon the same principle, and perhaps also the use of a strong fire, as an auxiliary disturbing force, we repeat the conviction that we might have driven our heading from the shafts nearly, or quite, a quarter of a mile in each direction, which would enable working shafts in similar tunnels to be spaced at *half a mile asunder*, whilst intermediate air shafts would become entirely unnecessary.

Fig. 4 exhibits a vertical section of the tunnel and its shafts, with the points of junction of the headings.

Fig. 5. exhibits a plan of the mode of ventilation designed for the shaft workings, in case the air became foul.

Referring to Fig. 5, D being the wettest and coldest, was designed to be the downcast, and C the upcast shaft; the air descending D would pass in the direction of the arrows, around the partition, close to D's heading, and thence returning on the opposite side of it, pass close to C's heading, and turning again, finally ascend the shaft C. In heavy weather a fire would doubtless have been required at the foot of the upcast shaft.

It will be observed that from the south portal, the heading twelve feet and a half high, was driven 1503 feet inward, the bottoming at the time of junction being 980 feet in, or the tunnel for that distance presenting a section of twenty-five and a half feet altitude, by a width of twenty-seven feet; the atmosphere in the heading remained quite pure and easy to breathe, up to the last moment. Here it will be noticed that the only external disturbing force operating to produce ventilation, was the difference of level between the crown and floor of the tunnel, or twenty-five and a half feet; and yet this and incidental causes kept the air within constantly in motion, and in a state quite fit for respiration. In clear and cold weather, the atmosphere within the tunnel being warmer than that without, the cold air would force in along the floor of the work, and a brisk current, indicated by the floating powder smoke, would be visible, moving out along the roof. On the other hand, in damp and sultry weather, the air in the tunnel, cooled by the rocks, and the evaporation from the wet floor and dripping sides, would become colder than the external atmosphere, and then the smoke from the blasts would roll along the heading floor, and tumbling over the bottom breast like water, be seen flowing out of the tunnel close to the ground; thus indicating that at such times the fresh air was entering along the roof. Of course there were periods (though rarely,) when the atmosphere within and without would approach nearly to equilibrium, and on those occasions the air inside

would necessarily be rather close; but even then the frequent blasting, or even the variation of temperature caused by the motion of the sun, would quickly induce a relieving change, so that no complaint of impure air ever proceeded from the miners of the work; and there is strong reason to believe that in a tunnel of the dimensions of this one, by keeping the bottom breast close up with the heading, a distance of *half a mile* under ground might be driven from an open portal, without requiring any artifice to produce sufficient ventilation. Similar reasoning applies to the heading which was driven south 780 feet from shaft D, without any injurious or oppressive effect upon the lungs being noticed.

In both these cases, and in fact in the whole phenomena of ventilation, as witnessed in the perforation of this tunnel, we trace at once the operation of the simple principle with which we set out, namely, that we can always command a good ventilation whenever we possess the means of *continually destroying the equilibrium of the atmosphere at the spot to be ventilated.*

A perfect illustration of the observations of Professor Olmsted, upon a great scale, was noticed in our tunnel, after the shaft workings had been united together and driven out to the north portal, but before the juncture had been effected between the heading from shaft D, and that entering from the south portal. Throughout the *summer*, the column of air in shafts A and B being colder than the atmosphere at the north portal; and the column in shafts C and D, owing to their depth and increased wetness, being colder than either, a strong draught was found descending shafts A and B, and rushing out at the north portal—whilst a similar current was at the same time flowing down C and D, and from thence passing north to the feet of A and B, and there uniting with the currents of air from them both, would continually pass out at the north portal, bearing along with them the gunpowder smoke from the blasts, at times very briskly. This is precisely the result which Professor Olmsted's reasoning would lead us to expect. And again, during the *winter*, the ventilating currents were reversed, and the air then entering at the north end, was constantly found in a current moving south and ascending by all the shafts. This, too, is a result which was to be anticipated, because during cold weather the temperature of the external air being considerably lower than that of the tunnel and shafts, the outer column would necessarily preponderate, and the colder atmosphere forcing inward, would inevitably produce the southerly flow and ascending shaft currents, which were often noticed by the writer as actually existing during the season of cold.

We are perfectly aware that all we have above stated is as familiar

to the old miner as the flame of his candle; but we have nevertheless thought that there might be many of our readers who may have reflected as little upon this matter as was the case with the writer when his professional duties in connexion with the tunnel we have mentioned brought his mind to bear upon the subject.

Architecture.

On Chromatics as pertaining to Architecture. By THOMAS U. WALTER, *Architect.*

The importance of colour in producing architectural effect renders the subject of chromatics one of peculiar interest, not only to the architect, but to all who are in any way concerned in the construction of buildings. No matter how perfect and beautiful the forms and proportions of an object of taste may be, if the colours of the masses of which it is composed are glaring and inharmonious, the ideas it engenders will be precisely of the same cast; and, even supposing the taste of the spectator to be so well cultivated as to enable him to discern the beauties of its form through the distorting mask of discordant colouring, it will still fail to awaken agreeable emotions of taste.

The art of combining and arranging colours with reference to their operation on the mind, is regulated by laws which depend as decidedly on natural principles as those which govern the composition of sounds in music; and although there may be an endless variety of tastes, both in regard to individual hues, and to styles of composition, it is nevertheless true that any violation of the laws on which the harmony of colouring is founded cannot fail to produce an effect as disagreeable to the eye, as that which a deviation from the laws of harmony in music occasions to the ear; a knowledge of these laws is therefore indispensable to the production of beauty in architecture.

We frequently, however, find individuals totally unacquainted with the laws of harmonious colouring, who, nevertheless, possess a natural taste by which they are unconsciously led, in the arrangment of colours to the most pleasing results; but this taste is like what is termed "a good ear for music" unimproved by a knowledge of the science. We often hear both vocal and instrumental performances by persons who have no knowledge whatever of the laws of harmony; and even admitting such music to be agreeable, which is certainly not always the case, it would not be the less so if the performers understood their art. The same observations hold good in regard to colour. If an individual possesses a natural taste for the harmonious arrangement

of colours, that taste will undoubtedly be confirmed, strengthened, and purified by a knowledge of the natural laws on which chromatics are founded.

All the colours to be found in nature are embraced in three genera, denominated *primary*, *secondary*, and *tertiary*.

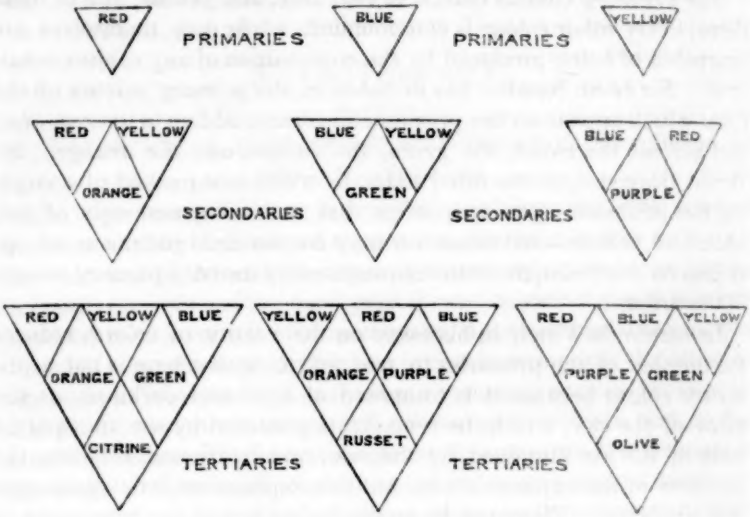
The *primary* colours consist of *red*, *blue*, and *yellow;* and of these three, every other colour is compounded, while they themselves are incapable of being produced by the composition of any colours whatever. Sir Isaac Newton has included in the primary colours all the hues which appear on the prismatic spectrum; adding to the *red*, *blue*, and *yellow*, the *violet*, the *green*, the *indigo*, and the *orange*. Sir David Brewster, on the other hand, by a different method of analyzing the prismatic spectrum, infers that it is composed only of red, blue, and yellow—and whatever may be the final judgment of opticians on this point, these are unquestionably the only primary colours of the artist.

Leonardo da Vinci, in his essay on the beauty of colour, reduces the number of the primaries to *two*, affirming that blue is not a primative colour because it is composed of light and darkness, as the azure of the sky, which, he remarks, is produced by the transparent body of the air illumined by the sun, and interposed between the darkness of the expanse above; but this explanation is destitute even of plausibility. There can be no doubt that blue is the true colour of the air itself, which it exhibits, notwithstanding its transparency, when seen in large masses. Indeed it must be obvious that if blue is any colour at all, it is most certainly a primitive, as neither of the other colours enter in any degree whatever into its composition.

The *secondary* colours are such only as can be resolved into two primaries; they also consist of three, one of which is *orange*, or a composition of red and yellow; another *green*, or a mixture of blue and yellow; and the third *purple*, or a compound of blue and red.

The *tertiary* colours are those which admit of being compounded of, or resolved into, two secondaries, or the three primaries; they consist of *citrine*, *russet*, and *olive*. Citrine is a compound of green and orange, or of the three primaries with yellow predominating—that colour having entered into the composition both of the green and the orange. Russet consists of purple and orange, or the three primaries with red predominating—for the same reason. And olive is composed of purple and green, or the three primaries with a predominating blue.

These remarks will be exemplified by referring to the following diagram, on which the primaries red, blue, and yellow are first represented singly; secondly, in their binary combinations producing orange, green, and purple; and thirdly, in their triple combinations producing citrine, rutset, and olive.



These three genera comprehend all the colours which are positive or definite, and the three colours of each genus, variously compounded, so that neither predominates to the eye, constitute the *neutral* colours, of which white is the most perfect example, being constituted of a combination of all the primitive colours. When, for example, the rays of white light which proceed from the sun are refracted by means of a prism of glass, or by drops of rain, as in the rainbow, they assume all the colours to be found in nature; hence, as the mere interposition of a piece of white glass between the sun and the object upon which it may be shining, cannot by any means impart colour to its rays, the beautiful hues we see can be nothing more than inherent portions of white light.

In view of these considerations, it is obvious that *red*, *blue*, and *yellow*, are the foundation of chromatics. These colours are, however, too intense to be employed in their natural and uncompounded state, especially in large masses, as their glaring contrasts are always unpleasant to the eye, and are certain to destroy the beauty of any composition in which they are freely used.

No better example can be referred to in illustration of the disagreeable effects arising from broad surfaces of primative colours than the red brick fronts of some of our city houses. This crude and fiery colour presents itself in every street, in painful dissonance, with all the tints and hues to which it stands related, and as the consequence, produces an effect exceedingly repulsive to every one whose taste has been trained to a perception of the beautiful. So completely has custom triumphed over the taste of many of our citizens, that even the reddest of red bricks are not yet red enough for them, and we often observe them painting their houses still redder; and then to heighten the incongruity, the joints are carefully pencilled the most glaring white. This is the very worst adaptation that could possibly be conceived of the most unsuitable of all colours for architectural effect. If all brick houses were painted some agreeable *neutral* colours, the appearance of our cities would be improved beyond calculation.

"From the positive nature of *red*," says an excellent writer on chromatics, "there is no colour requires more toning and managing, when exhibited in large masses;" and yet, in American cities, no colour is so lavishly and recklessly used as this. It should also be remarked, that if either of the other primaries were employed in a similar manner, the result would likewise be unpleasant. An agreeable architectural effect can never, under any circumstances, be produced where intense colours are freely used.

Burke, speaking of the effect of colour on the mind, observes that "those which seem most appropriate to beauty are the milder of every sort;" and Mr. Lush, in an essay on beauty in architecture says, "nature teaches us that all vivid and intense colours should be used with a sparing hand;" while Blair affirms that "colours chosen for beauty are generally delicate rather than glaring."

It should further be observed that even in the application of the intermediate hues, the strictest regard should be had to their arrangement, as without suitable contrasts balanced by concord and harmony, any composition will appear monotonous. Mr. Field says, in his Analogical Philosophy: "We acknowledge the power of colours to sooth and delight by gradation of hue and shade, to excite and animate by various contrasts, and to distract and repel by infraction and discordance." And again: "The eye is quiet and the mind tranquil and complacent, when colours are opposed to each other in equivalent proportions chromatically, or in such proportions as neutralize their individual activity."

Our own experience teaches us that in order to allow the mind to pass with pleasure and facility from one image to another—from the impression of one object to that of another—the various effects must

be so harmonized as to leave no glaring object in the composition to arrest the attention, or start an unconnected thought. When, therefore, we seek to achieve effect by violent contrasts in colour, it is evident that the very opposite of beauty must be the certain result.

If, then, the beauty of an architectural object depends upon the harmonious colouring of the masses of which it is composed, it is evident that the same harmony must prevail in all the decorations and furniture of the building, or the composition will fail to be agreeable, even though its architecture be faultless. Hence, no one object in an apartment ought to be allowed to monopolize attraction; but everything should be so toned and balanced in its individual effect, as neither to interfere with the idea of a unity of design, nor tend to monotony.

These obvious deductions from the laws of harmony seem as yet to have been but seldom thought of. Apartments are usually painted without reference to any particular key of colour, and without the slightest regard to the furniture intended for their embellishment—in the choice of which either novelty, or its opposite extreme, the fashion of the day, is too often allowed to usurp the place of taste and reason; thus the most incongruous mixtures are frequently produced, and the effect of apartments which are beautiful in themselves wholly destroyed by the introduction of discordant colours, as well as by inharmonious forms.

Mr. Hays observes, in his excellent treatise on the laws of harmonious colouring, (p. 25,) that "the tone or key of colour is the first point to be fixed, and its degree of warmth or coldness will be regulated by the use, situation, and light of the apartment. The next point (he remarks) is the style of colouring, whether gay, sombre, or otherwise; this is more particularly regulated by the use of the apartment, and the sentiments which it ought to inspire; for as Sir Joshua Reynolds says, 'what may heighten the elegant may degrade the sublime.'

The tone or key of colour for an apartment should be fixed by the choice of the furniture, as that may be considered in regard to colouring in the same light as the principal figures in a picture. The general tone of the room must, therefore, depend in some degree on the colours of which the furniture is composed; if, for instance, the prevailing colour be blue, grey, cool-green, or lilac, the general tone must be cool; but if, on the other hand, it should be red, orange, brown, yellow, or a warm tint of green, the tone must be warm." It should, however, be observed, that these remarks relate only to the prevailing tints, as well managed contrasts are as necessary to the beauty of an apartment as they are to the beauty of a picture.

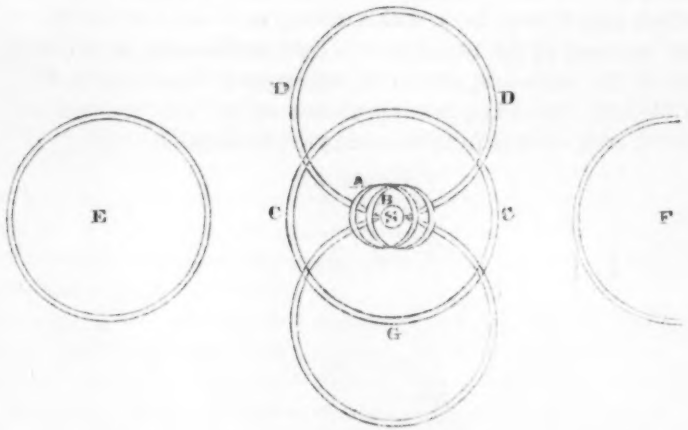
It may, perhaps, be objected, that by thus reducing taste to rule, we circumscribe genius. This might indeed be true of those who,

from a want of ability, use rules without a comprehension of their rationale; but rules are founded on reason, and so far from any fetters being imposed on genius by reason, genius itself is the highest possible grade of reason, in a latent state, operating, as it were, unconsciously by natural rules.

Physical Science.

An account of some Parhelia observed at Milford and Camden, Delaware, March 14th, 1841. By A. D. CHALONER, *A. M., M. D., Recording Secretary of the Academy of Natural Sciences of Philadelphia, &c. &c.*

Figure 1.*



The following is the account of the parhelia as seen at Camden, seventeen miles northwest of Milford. The day before (13th inst.) was clear, but some two or three days previous there had been some heavy rain. The morning of the 14th inst. the sun rose with unusual brightness with a clear sky; at 8 o'clock, A. M., the sky appeared to grow ropy, with uneven crossings in all directions, which first attracted attention. At 8½ o'clock the sun was surrounded with a circle, which then became of a dim appearance and of a *white* color; at 9 o'clock two circles, A B, appeared, with a *halo* around the sun, as represented by the letter S, fig. 1. A similar circle, G, was formed in the south, and in about ten minutes was completed, and at the same time the circles C, D, and E, appeared in like manner. At 9½ o'clock

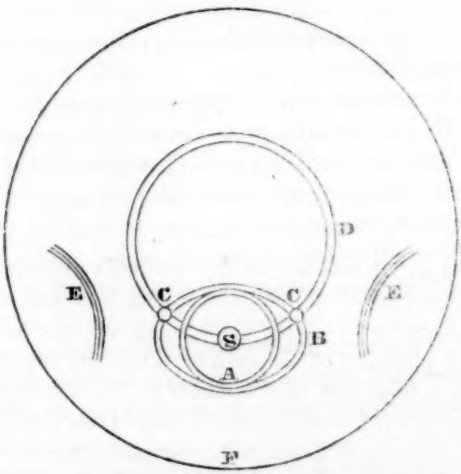
* For this description and drawing I am indebted to the kindness of A. Jackson, Esq., of Camden, Delaware, through Mr Thomas Oliver, of Philadelphia.

the circle F appeared in like manner; the color of all the circles was of a *sky red*, with the outer edge more of the tint of a rain-bow; in *ten minutes* more, they were of their brightest colors; at 9½ o'clock the circles were all full. The circle F never appeared to be a *full* circle; the altitude of the circles A and B gave an angle of 29°, though somewhat oval, caused by the shadow over them. The circles G, C, and D, cutting the sun's centre, gave each an angle of 69°. The circle E, from its nearest point to the sun, gave an angle of 75°, while F gave an angle of 32°; these circles stood due east and west from the sun, G and D due north and south.

At 10 o'clock the circles disappeared gradually, and at 10½ o'clock they had vanished as they came on; at 12 o'clock there remained one circle around the sun, which continued until the evening. The next day the sky was hazy, and a storm of rain, hail and snow came on which lasted three days, with a strong north-east wind. The wind on the morning of the 14th inst. was light south-west, at 10 o'clock it shifted to the north-east, and in the afternoon it was strong north-east.

At Milford, Delaware, the appearance of the sun was somewhat different, as is evident from the following description.

Figure 2.*



Imagine a brilliant white circle, D, fig. 2, having the zenith for its centre, and passing through the body of the sun, then a beautiful double iris, A and B, (in figure resembling the telescopic appearance of Saturn and his ring,) encircling the sun, S. Then two parhelia, C C, at the intersections of the circles, in splendor rivaling the great

* This account and drawing is by David Straughn, Esq., of Milford, Delaware.

luminary himself; then parts of two great circles, E E, of a rainbow color, pointing to the horizon, F, and you have an idea, and only an idea, of the transcendent scenery of the heavens, at once beautiful and sublime, equally calculated to excite the fears of the ignorant, who view it as an omen of disaster, and the admiration of the intelligent, who regard it as the result of the laws of nature. This phenomenon was first observed at 9½ o'clock A. M., and continued until 10 o'clock A. M. The sky was free from clouds, but the atmosphere was hazy, the weather was mild and calm. It was not seen more than fifty miles distant from Milford; it was preceded by a shower from the north-west which cleared up with a brilliant sunset. On the 17th inst. an unusually severe snow storm for the season took place.

Another observer at Milford, Delaware, remarks that the sky was hazy on the 14th of March, at 10 o'clock A. M., without any appearance of clouds, the sun was of a whitish color and pale; so pale or dim that the shadow of an object that intervened could barely be seen. There were two circles around the sun, and in the first circle were *four parhelia*, colored with all the colors of the rainbow.*

The parhelia appeared to be east and west, north and south in the first circle, at the westerly one there was an arch in the form of a rainbow extending to the north-west, but of a yellowish white color. For an explanation of this phenomenon the reader may consult Brewster's Optics, page 227–260.

On examining the monthly meteorological reports for March, 1841, made to the Franklin Institute, from the different counties of Pennsylvania, I find that from the 14th to 17th of March there was an unusual prevalence of *stormy weather*, rain and snow of great depth, but at Silver Lake, Pennsylvania, vice versa, being dry, fine and clear; a similar state of weather being observed on the 14th inst. at Milford and Camden, Delaware, where the above appearances were observed.

At Little Creek landing, Kent county, Delaware, about three miles east of Dover and two miles from Delaware Bay, on March 15th,† 1841, the following appearances were observed by Mr. Charles P. Hayes.

"There was, in the first place, a very large circle around the sun which was intersected by two others whose tangents were the centre of the sun, each having a central bright spot, resembling the sun shin-

* I am indebted to Mr. Thomas Oliver, of Philadelphia, for his kindness in procuring information for me upon this subject.

† There is *probably* a mistake in this date (15th inst.) as the *parhelia* were observed at Milford and Camden, Delaware, at the same time, March 14th; all other accounts coincide as to the time.

ing through a thin cloud. But one of the most striking points in the scene was a beautiful rainbow *immediately under the sun*, which at this time shone bright and warm, the sky being almost clear.

On Wednesday afternoon, the 17th inst., a heavy snow storm took place.

Remarks relating to the Tornado which visited New Brunswick, in the State of New Jersey, June 19, 1835, *with a Plan and Schedule of the Prostrations observed on a section of its track. By* W. C. Redfield, Esq.

Communicated by the Author.

In a paper printed in the American Journal of Science, in which I referred to the support given by Prof. Bache to Mr. Espy's theory of storms, at the meeting of the British Association in 1838, founded upon observations made on the New Brunswick tornado, I have stated, that in my own examinations I had observed numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the whirling vortex at the surface of the ground; and further, that the direction of rotation was *towards the left*, as in the North Atlantic hurricanes.* It was due to Professor Bache that my observations should be brought forward; a task which has been too long delayed, partly from a desire that he would revise his former conclusions. The facts now presented form part of the evidence to which I then alluded.

If the effects which I present for consideration be due to "a moving column of rarefied air without any whirling motion at or near the surface of the ground," as maintained by Professor Bache,† we might expect to find a relative uniformity in these effects on the two opposite sides or margins of the track. How far this is the case may be seen by inspecting the observations which are found upon the annexed plan of prostrations.

The occurrence of these tornadoes appears to have been noticed from the earliest antiquity; and their violence has been considered as the effect of an active whirling motion in the body of the tornado; this peculiarity of action having often been supported by the testimony of eye-witnesses.

The whirling motion, however, has not been recognized by Prof. Bache, Mr. Espy,‡ or Prof. Walter R. Johnson,‖ in their several

* American Journal of Science, October, 1838, vol. xxxv, pp. 206, 207.

† Transactions of the American Philosophical Society, vol. v, p. 417, New Series.

‡ Transactions of the American Philosophical Society, vol. v, New Series.

‖ Journal of the Academy of Natural Sciences of Philadelphia, vol. vii, part ii.

accounts of the New Brunswick tornado; these writers having been led to adopt or favour a theory of ascending columns in the atmosphere, founded on the supposed influence of calorific expansion accompanying the condensation of vapor.

It is remarkable that previous to this period the evidences of the rotation, or other characteristic action, of tornadoes appear not to have been duly examined and recorded, nor even to have received the distinct consideration of scientific observers. We are therefore left to seek out the peculiarities of their action, by examining the direction of the prostrations and other effects of the wind; and from a careful induction from the effects which are thus registered as by the finger of the tornado, we may hope to arrive at satisfactory conclusions.

If the numerous prostrations of trees and other objects, which may be observed in the path of a tornado, be the effects of a violent whirlwind, it appears most reasonable to infer that this whirl had the common properties which may be observed in all narrow and violent vortices, viz: *a spirally descending and involuted motion* of the exterior and lower portions of the vortex, rapidly quickened in its gyrations as it approaches toward the centre or axis of the whirl, and thence continued (in the case of the whirlwind) spirally upward, but gradually expanding in its spiral course by an evolute motion in ascending towards the extreme height of the revolving mass.

If we now contemplate the action of this whirling body, while in a state of rapid progression, on the several objects found in distinct portions of its path, we may expect to witness effects of much complexity, particularly as regards direction; and, also, that amid this apparent complexity, some clue may be obtained that will serve to indicate or establish the true character of its action. Some of the effects which may be expected, or observed, will be here considered.

1. We may expect to find, in the path of the whirlwind, strong evidence of the inward or vorticular course of the wind at the earth's surface; the violence of which inward motion is clearly indicated by the force with which various objects, often of much weight, are carried spirally upward about the axis of the revolving body.

Now the effects of this inward vorticular motion at the surface of the ground, are clearly manifested in the cases before us; and are also well illustrated by Prof. Bache, in his paper on this tornado, although referred by him to a different action.*

2. As the effects which may be observed at various points in the track were produced at different moments of time, and by forces acting in different directions, as well as of various intensities, we may expect to find great diversities in the several directions of the fallen trees and other prostrated bodies; and further, as all the forces, in

* Transactions of the American Philosophical Society, vol. v.

addition to their inward tendency, have likewise a common tendency in the direction pursued by the tornado, we may expect to find, also, full evidence of this progressive force in the direction of the fallen bodies.

These effects, I need hardly state, are distinctly observed in the case before us; and appear likewise from the observations of Professor Bache. The results already noticed have been observed also in the tracks of other tornadoes: so that a general inclination, both inward and onward, amid the various and confused directions of the fallen bodies, is distinctly recognized by all parties to this inquiry.

3. It has been often noticed, that where two fallen trees are found lying across each other, the uppermost or last fallen points most nearly to the course pursued by the tornado.

In view of the facts above stated, much pains have been taken to establish, by induction, a central and non-whirling course in the wind of the tornado; first inward and then upward, like that resulting from a common fire in the open air. I do not propose to notice the insuperable difficulties which appear to attend this hypothesis. It is important to state, however, that all the above mentioned effects, when theoretically considered, are, at least, equally consistent with the involute whirling action of an advancing vortex. This important consideration I have not seen recognized by the advocates of the non-whirling theory; and it seems proper, therefore, to point out, as we proceed, other and more distinguishing effects of the whirling action.

4. It has been noticed, also, that the directions given to broken limbs and other bodies, by the successive changes in the direction of the wind as the tornado passed over, have been found in opposite courses of change, on the two opposite sides of the track.

This fact, too, has been strongly urged as disproving a rotary motion. But, unfortunately for the objection, this effect accords fully with the rotary action of a progressive mass of atmosphere; as is well known to all who clearly understand the *theory* of rotary storms.

In all such whirling masses the successive changes in the direction of the wind *result solely from their progressive motion*, and necessarily take place in opposite directions or courses of change on the two opposite sides of the advancing axis. This indication fails, therefore, as a theoretic test; and I now proceed to notice others, which are peculiar to a progressive whirling action.

5. In considering further the effects of such action, we may expect to find that the greatly increased activity of gyration which is always observed near the centre of a vortex, will be indicated by a more violent and irregular action in and near the path pursued by the axis of the whirlwind, than is found under its more outward portions.

This effect is often strikingly exhibited in the path of tornadoes; while, in the supposed ascent of a non-whirling column, it would seem that no part of the surface would be so much exempted from its action, and particularly from its power of prostration, as that lying near its centre.

6. As the effect of rotation must be to produce, on one side of the advancing axis, a reverse motion which is contrary to the course of the tornado, it is evident that on this side the prostrating power will be much lessened; that the cases of prostration, therefore, will be here less numerous; and that some of these, at least, will be produced in a backward direction, more or less opposite to the course of the tornado. By this criterion, not only the whirling movement, but the direction of the rotation also, may be clearly ascertained.

This effect is best observed by comparing the two opposite margins of the track, and is strongly exemplified in the case before us. Here we find, that most of the trees prostrated within five chains (110 yards,) from the northern or left-hand margin of the track, lie in directions which are more or less backward from the course of the tornado. The prostrations in this part of the track are also for the most part less general than on the opposite side of the axis,* a greater portion of the trees being left standing.

It sometimes happens, owing perhaps to the inward or involute motion having exceeded the progressive motion at a particular point, that some inclination backward will be found in the prostrations on the progressive side of the whirl, as seen on the sketch, Nos. 77 to 80. But these unfrequent cases by no means compare with the numerous backward and sometimes *outward* prostrations, found on the reverse side of the whirl, as illustrated by Nos. 1, 3, 4, 7, 9, 10, 12, 13, &c. on the left side of the track. Thus we find here a satisfactory indication that this tornado was a whirlwind; and that the course of its rotation was to the *left* in front.

7. It is also apparent, that the prostrating power of a whirlwind on the side of its reversed motion as just considered, will be limited to a shorter distance than on the opposite or progressive side of its axis.

This is seen in the more limited *extent* of the prostrations on the north or left margin of the track, as compared with the extent of those which incline inward on the right side of the apparent axis. There were many trees standing beyond the northern border of the track, but none had fallen.

* There was a vacant space in the belt of wood, immediately to the right of the line *c c*, or axis of the tornado, owing to which the effect mentioned does not appear so obvious in the figure.

SCHEDULE OF THE PROSTRATIONS

Observed on a Section of the Track of the New-Brunswick Tornado, of June 19th, 1835.

No.	Direction of Prostration.	Inclination.
	TABLE I. Left side of the track to the line *b b*—5 chains.	Inward and backward.
a	Tree lies S. 20° W. . .	110°
b	.. .. S. 80 W. . .	170
1	.. .. N. 67 W. . .	203
2	.. .. S.	90
3	.. .. W.	180
4	.. .. S. 80 W. . .	170
5	.. .. S. 40 W. . .	130
6	.. .. S. 40 W. . .	130
7	.. .. S. 80 W. . .	170
8	.. .. S. 10 E. . .	80
9	.. .. S. 50 W. . .	140
10	.. .. S. 50 W. . .	140
11	.. .. S. 26 W. . .	116
12	.. .. S. 50 W. . .	140
13	.. .. S. 65 W. . .	155
14	.. .. South . . .	90
	Mean direction, 16 cases, S.48°W. Mean inclination from course, inward and backward, 138 degrees.	
	TABLE II. Left side of the axis, from the line *b b* to *c c*—1½ chains.	
15	Tree lies S. 2° E. . .	88
16	.. .. S. 12 W. . .	102
17	.. .. S 35 E. . .	55
18	.. .. S. 62 E. . .	28
19	.. .. S. 25 E. . .	65
20	.. .. N. 80 W. . .	190
23	.. .. S. 20 E. . .	70
24	.. .. S. 80 E. . .	10
25	.. .. S. 45 E. . .	45
26	.. .. S. 10 E. . .	80
27	.. .. S. 45 E. . .	45
28	.. .. S. 20 E. . .	70
29	.. .. S. 60 E. . .	30
30	.. .. S 60 E. . .	30
31	.. .. East. . . .	00
32	.. .. S. 75 E. . .	15
33	.. .. S. 56 E. [Included as belonging by its inclination to this table.]	34
35	.. .. East . . .	00
	Mean direction, 18 cases, S. 37° E. Mean inclination inward, 33 deg.	
	TABLE III. Right side of apparent axis from line *c c* to W E—3 chains.	
21	Tree lies N. 56° E. . .	34
22	.. .. N. 60 E. . .	30
34	.. .. N. 80 E. [Included as belonging by its inclination to this table.]	10
36	.. .. N. 85 E. . .	5
37	.. .. East (two) . .	0
..	.. .. East . . .	0
38	.. .. East . . .	0
39	.. .. N. 30 E. . .	60
40	.. .. N. 70 E. . .	20
41	.. .. N. 55 E. . .	35
42	.. .. N. 50 E. . .	40
43	.. .. N. 78 E. . .	12
44	.. .. N. 45 E. . .	45
45	.. .. N. 45 E. . .	45
46	.. .. N. 25 E. . .	65
47	.. .. N. 35 E. . .	55
48	.. .. N. 40 E. . .	50
	Mean direction, 17 cases, N.60° E. Mean inclination inward, 30 deg.	

No.	Direction of Prostration.	Inclination.
	TABLE IV. Right side of axis, from line W E to line *a a*—4½ chains.	Inward and backward.
49	Tree lies N. 67° E. . .	23°
50	.. .. N. 45 E. . .	45
51	.. .. N. 22 E. . .	68
52	.. .. N. 3 E. . .	87
53	.. .. N. 30 E. . .	60
54	.. .. N. 10 E. . .	80
55	.. .. N. 35 E. . .	55
56	.. .. North . . .	90
57	.. .. N. 10 E. . .	80
58	.. .. N. 3 E. . .	87
59	.. .. N. 45 E. . .	45
60	.. .. N. 10 E. . .	80
61	.. .. N. 35 E. . .	55
62	.. .. N. 60 E. . .	30
64	.. .. N. 40 E. . .	50
65	.. .. N. 20 E. . .	70
66	.. .. N. 10 E. . .	80
67	.. .. N. 20 E. . .	70
68	.. .. N. 40 E. . .	50
69	.. .. N. 70 E. . .	20
70	.. .. N. 50 E. . .	40
71	.. .. N. 35 E. . .	55
72	.. .. N. 30 E. . .	60
73	.. .. N. 50 E. . .	40
74	.. .. North (two) .	90
75	.. .. North " .	90
76	.. .. North " .	90
77	.. .. N. 20 W. (clump of 3)	110
78	.. .. N. 35 W. . .	125
79	.. .. N. 30 W. . .	120
80	.. .. N. 10 W. . .	100
81	.. .. N. 65 E. . .	25
82	.. .. N. 70 E. . .	20
	Mean direction, 33 cases, N. 24° E. Mean inclination, 66 degrees.	
	TABLE V. Right side of track, from line *a a* to outward limit of prostration—5 ch.	
63	Tree lies N. 65° E. . .	25
83	.. .. N. 45 E. . .	45
84	.. .. N. 40 E. . .	50
e	.. .. N. 55 E. . .	35
85	.. .. N. 70 E. . .	20
86	.. .. N. 23 E. . .	67
87	.. .. N. 31 E. . .	59
88	.. .. N. 20 E. . .	70
89	.. .. N. 22 E. . .	68
90	.. .. N. 10 E. . .	80
91	.. .. N. 55 E. . .	35
92	.. .. N. 70 E. . .	20
93	.. .. N. 55 E. . .	35
94	.. .. N. 68 E. . .	22
95	.. .. N. 25 E. . .	65
	Mean direction, 15 cases, N. 44° E. Mean inclination inward from course of tornado, 46°.	

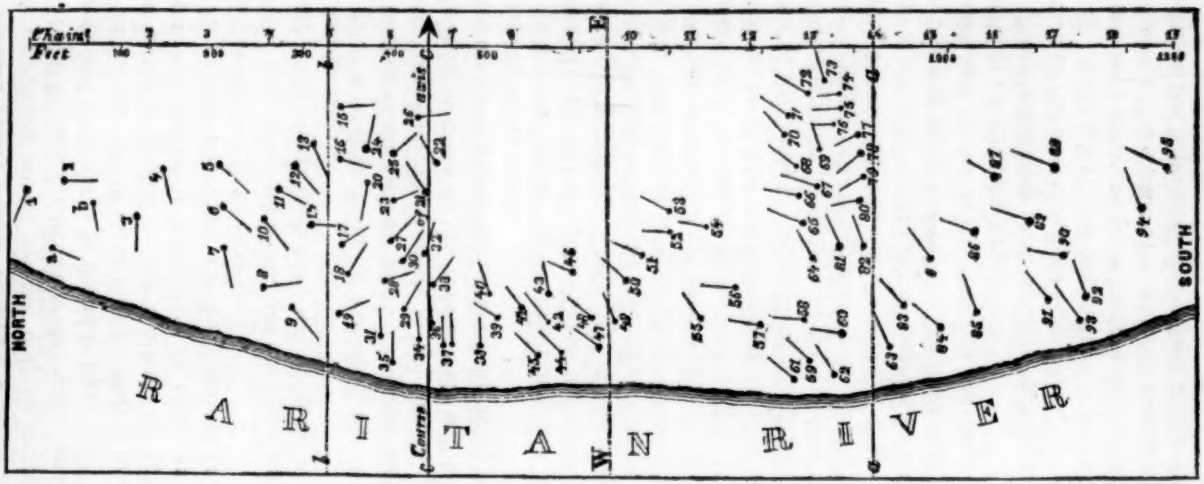
Mean direction of all the prostrations on *left* of axis, 34 cases, S. 5° W.—being 3° backward, or 93° inward and backward.

Mean direction on *right* of axis, 65 cases N. 38° E.—being 52° inward from course.

Difference of mean inclination on the two sides, 41 degrees.

Difference of opposite marginal sections (Tables I and V) 92 degrees.

NEW-BRUNSWICK TORNADO. (Plate I.)



Sketch of the Prostrations found on a section of the Track of the Tornado of June 19, 1835, *on the bank of the Raritan, opposite the City of New Brunswick, in the State of New-Jersey.*

EXPLANATIONS.—The east bank of the river is here covered with a belt of wood; the latter having a very irregular outline on the east, where it is bounded by a clear field. The line *c c* represents the apparent course of the axis of the tornado: W. west, E. east. The large dots on the several figures show the root ends of the trees, which were chiefly a species of cedar. In all these cases of prostration, part of the roots were still fast in the ground. Course of the tornado east. The approximate positions of the several trees are in many cases slightly changed in the sketch, for the purpose of a distinct exhibition of each.

Note.—This bank of the river is intersected by small ravines with wooded margins, one of which is nearly opposite to chain 5, and another is near chain 13, and which cause most of the irregularity in the wooded outline.

8. It follows, in like manner, that on that side of a whirlwind in which the rotary motion coincides with the progressive movement, the prostrating power will not only be increased in its intensity, but will also be effective over a wider space; and that few, if any, of the prostrated bodies will be found to have been thrown backward.

In the case before us, as may be seen in the sketch, the prostrations are found to extend on the southern or right side of the apparent axis to a distance nearly twice as great as on the left side. The same general result has also been noticed in the tracks of other tornadoes which I have examined.

The facts here considered are too important to be overlooked, and seem fully to establish both the whirling action and the course of rotation.

9. If a rotative action be exhibited, the mean directions of all the prostrations, on each of the two opposite sides, will differ greatly in their respective inclinations to the line of progress, and the mean direction of those on the reverse side will be found more backward than on the opposite side, where the rotative course coincides with the progressive action.

In the case before us, the mean direction of all the prostrations on the right side of the track is found to incline 52 degrees inward from the line of progress. The course of the tornado is here taken to be east; although for the last half mile its course had been a little north of east. On the left side, the mean direction is found to be S. 3° W., or 93 degrees inward and backward; a difference in the mean inclination from the course on the two sides of 41 degrees.*

If we now take the indications afforded by the two exterior portions of the track, to the width of five chains on each side, where the effects are more distinctive in their character, we find on the right side a mean inward inclination of 46 degrees, the mean direction being N. 44° E.; while on the left side of the track the mean inclination is not only inward but 48 degrees backward, the mean direction on this side being S. 48° W. We have thus a mean difference in the inclination of the fallen trees, on the two exterior portions of the track, of no less than 92 degrees.

These indications seem conclusive, also, in favour of the whirling action in the direction from right to left.

10. Although of less importance, it should be mentioned that the diminished action of the tornado which is commonly observed on the hillsides and summits over which it passes, and the greatly increased action in the bottoms of the valleys, and even in deep ravines, afford

* The inclinations of the fallen trees from the course, on both sides of the axis, are reckoned inward and backward.

a strong argument against ascribing the effects to the ascent of a non-whirling rarefied column; as the latter, it would seem, must act with greater force on the hillsides and summits than in the bottoms of valleys. The general correctness of the observation above stated cannot justly be questioned.

11. The sudden and extraordinary diminution of the atmospheric pressure which is said to take place at the points successively passed over by a tornado, causing the doors and windows of buildings to burst outwards, seems to afford strong confirmation of a violent whirling motion; for an effect of this kind is necessarily due to the centrifugal and upward force of the vorticular action in the interior portion of the whirlwind. There are no other means known by which such an abstraction of pressure can be effected in the open air. An increase of calorific elasticity, if such were produced, either generally or locally, would not greatly disturb the equilibrium of pressure, being resisted by the surrounding and incumbent weight of the entire atmosphere. Besides, the immediate effect of such increased elasticity might rather be to burst *inward* the windows and doors of buildings exposed to its action.

Some of the more important indications mentioned above appear also from an examination of Prof. Bache's observations; although the latter are not definitely located by him, as regards the extreme borders of the track. Thus, in Fig. 7 of Professor Bache's paper, assuming the course of the tornado to be east, and rejecting a few observations near the centre, to avoid error, we find in twenty observations on the right side of the track, a mean inward inclination of 64 degrees; and for nine observations on the left side, a mean inclination, reckoned inward and backward from the course, of 104 degrees, being 14 degrees backward.

It is stated by Prof. Bache, "that the trees lying perpendicular to the track of the storm, are not those furthest from the centre of that track." This generalization accords with my own observations; but can hardly be reconciled with an inward non-whirling motion in the tornado.

It may appear to some, that in the case of a whirlwind the greater portion of the prostrations on the reverse side of the axis should be found in a backward direction; and so they would undoubtedly be found, were it not for the inward and the progressive action. But the force is here so far lessened by the reverse action above noticed, that in most cases only a small portion of the trees exposed will be thus prostrated; while the greatest force of the whirlwind, on this side, is felt near its last or closing portion and towards the apparent axis, where the inward, together with the rotative and progressive

forces, seem to combine their influence in the closing rush towards the heart of the receding vortex. This appears to account for the nearly opposite directions of prostration found on this side, and it is apparently by this more violent closing action, that many trees which were first overthrown in a direction nearly across the centre of the path, were again moved from their position, and swept onward nearly in the course of the tornado. It is proper to remark here, that an attentive examination of these effects has served to convince me that on the right and more central portions of the track the prostrations for the most part take place either at the outset or under the middle portions of the whirlwind; while on the left or reverse side, up to the line of the apparent axis, and even across the latter, they occur chiefly under the closing action of the whirl, as above described. The violent effects of this central and closing action are more clearly seen as we advance from the left-hand margin towards the centre or apparent axis of the path.

From the causes to which I have just alluded, the effects are usually more violent on and near the line passed over by the axis, than in other portions of the track. This line of greatest violence is found to coincide nearly with the line which separates the inwardly inclined prostrations of the two opposite sides of the track.* The latter line or apparent axis of the track is sometimes called the line of convergence, and is indicated on the figure by the line and arrow *c c*. Along this line, from the causes just mentioned, aided also by the elevating forces about the axis, many of the trees are swept onward, and left with their tops in a direction nearly parallel to the course of the tornado; forming an apparent, but not a just, exception, to the more lateral direction which pertains to most of the trees prostrated by the onset of the whirlwind, near the central portions of the track. Indeed, the central or closing violence of the advancing whirl is here so great, that the trees are not unfrequently torn out of the ground and carried onward to considerable distances.

It is proper to state here, that in the tracks of all the tornadoes which I have had opportunity to examine, and in some, at least, of those examined by others, the course of rotation has been found the same as in the case before us.†

In order to make a just and satisfactory examination of the effects of a tornado, it appears necessary to select portions of the track where the extension of wood or single trees, on each side, is found sufficient

* The line of greatest violence, for the most part, is found somewhat to the right of the line of convergence.

† As in the tornado which passed through Alleghany county, New York, July 25th, 1838; described by Mr. Gaylord in the American Journal of Science, vol. xxxvii, p. 92.

to mark clearly the exterior limits of the prostrating power, and where the effects on both sides of the axis are also clearly developed. Our next care should be to ascertain, as near as may be practicable, the line which separates the opposite convergence of the two sides, noticed above as the axis or line of convergence. We should then determine the general direction of this line and of the track at the place examined; which being done, we may proceed to measure the distance to which the prostrations are extended on each side, and then carefully to take the position and direction of prostration of each and of all of the fallen bodies, noting with care, also, any other phenomena which may serve to aid our inquiries. We may thus obtain valuable materials for future analysis; and this course of investigation, if faithfully pursued, will, it is believed, remove all reasonable doubt of the rotative action of these tornadoes. An examination of their probable origin, and the causes of their enduring activity and violence, belongs not to the present occasion.

New York, 5th February, 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1840.

With Remarks and Exemplifications by the Editor.

1. For an improved method of taking *Daguerrotype Likenesses by means of a Mirror;* Alex. S. Wolcott, city of New York, May 8. (See specification.)

2. For an improvement in the *Stop-Cock for Water and Gas Pipes;* James Robertson, city of New York, May 8.

This stop-cock has a sliding valve resembling others which have been used, and it is so constructed as to admit of the easy sliding of the valve, and, at the same time, of its being pressed against its seat after it is in place; and also to admit of the cleansing of the chamber from any dirt that may accumulate within it.

The box is constructed as usual, with two side pieces, which fit into the pipe, and a top piece in which works the screw, which moves the valve up and down. The valve has three projections, one at top, with a vertical slot in which plays a projection from the nut that fits on the screw, and one ear at each side. The valve is pressed to its seat by what the patentee calls a "wedge," which is attached at top to the nut, and works up and down with it—it branches off, and each branch acts upon two projections on the back of the valve, one towards each edge. Each branch, at the edge, is provided with a projection which slides against the side of the box opposite to the valve seat. When the screw is turned with the view of shutting the

valve, the two branches of the wedge are resting on the top of the projections on the back of the valve plate, and thus as the wedge descends it carries the valve with it, without pressing it against its seat; but when the valve has reached the bottom, the two projections on the back of the branches of the wedge have reached two notches in the side plate of the box, which permit the branches of the wedge to slide over the projections on the back of the valve, and thus wedge it to its seat—the slot in the piece which projects from the upper part of the valve allowing the wedge to descend after the valve has reached the bottom. The bottom of the chamber is provided with a seat for a conical valve, which works up and down by means of a lever passing through the casing for that purpose—when the valve is lifted up the dirt passes out.

The claim is to "making the valve fit more firmly in its seat by means of the independent wedge, constructed and operating as described." And also to the "mode of cleansing the chamber from any dirt that may accumulate in it, by means of the escape valve, as described."

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3. For an improved *Tailor's Measure for taking measure for coats;* Richard Dame, Hanover, Grafton county, New Hampshire, May 8.

This is for improvements in what is generally known as the "Tailor's measuring square," and consists first of attaching an additional or extension branch at the end of the ordinary horizontal branch of the tailor's measuring square, at that end of it which forms the angle; and secondly, in providing the branches with sliding hinges, one half of each hinge being made to slide upon the branches, and the other having curved hooks, the points of which, in opening the hinges, catch the coat on the person to be measured, and then pass through holes in the other leaf, thus securing the instrument to the body—the claim is to the "attaching of the additional or extension branch at the end of the ordinary horizontal branch of the tailor's measuring square, by means of the hinge, and combining the branches and the sliding hinges for attaching said branches, as set forth."

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4. For a new mode of *Making Wigs;* Francis Bourgnet, city of New York, May 8.

Not being well versed in the art of making wigs, we will merely quote that part of the specification in which the inventor states the nature of his invention, and to this we will append his claim. "The nature of my invention consists in an apparatus whereby the pressure of the metallic spring may be varied at the will of the wearer." "What I claim as my invention, and desire to secure by letters patent, is the construction of the metallic wig with an additional transverse piece or spring, tempered soft, and flexible, so that it may be bent to any degree the wearer pleases, and of sufficient thickness to control the elastic spring, and keep it in the position to which it has been bent. I also claim the combination of the side plates for distributing the pressure with the transverse springs. Lastly, I claim in combination

with the above, the arch spring and oblique springs, the whole being constructed, and operating as herein described."

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5. For an improvement in the *Horse Power for driving machinery;* George Strenge, and Jacob Rohrer, Manhiem township, Lancaster county, Pennsylvania, May 8.

This is for an improvement in that kind of horse power in which the power is applied, by causing the horse to walk in a circle, and to draw by means of a lever or sweep, attached to a vertical shaft; and it consists in the peculiar manner in which the levers or sweeps are attached to the main driving wheel. The patentees observe that "sweeps of this description have heretofore been fastened to the main shaft in such manner as not to allow of their having any vertical play, in consequence of which, a considerable portion of the power of the horse or horses has been expended without the production of any useful effect, and has, in fact, been productive of injury, by racking the machine." In this machine the sweeps pass through staples attached to the main wheel, which staples are so formed as to confine the sweeps laterally, whilst they are allowed to play vertically. The inner ends of the sweeps are received within mortises in the upper end of the shaft, and there are springs on the upper and lower sides of the rear ends of the sweeps, which bear respectively upon the main driving wheel and upon the upper part of the staples. The upper springs are provided with an off-set to operate as a latch in confining the sweeps in place.

The claim is to the "allowing of a vertical play to the sweeps or levers, by causing springs to act upon their upper and lower sides, in the manner described."

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6. For improved *Brakes for Railroad Cars;* Matthew W. King, city of New York, May 8.

This brake is so constructed as to act against the insides of the two rails at the same time, there being two levers, each provided with a roller at its outer end. These levers are placed nearly at right angles to each other, and work on a stud suspended from the bottom of the car. Two connecting rods are jointed to each of these levers, and these connect them with a screw passing through a nut, so that when the said screw is turned one way, the rollers on the ends of the levers will be pressed against the insides of the rails, and when turned the other way, will be relieved from them. The screw is turned by means of a pinion attached to its outer end worked by a cog wheel, which can be actuated by the tender.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the compound lever brake, combined and arranged as herein described."

7. For an improvement in the method of *Teaching the art of writing;* called "the transparent writing guide;" William Davidson, city of New York, May 8.

The patentee says, "the nature of this invention consists in preparing the surface of a glass fixed in a frame, under which the copy to be imitated is placed, by rubbing over its surface a certain composition, which forms a surface that will receive an ink of a peculiar kind, transferred thereto by a pen of a peculiar construction, which prevents its too rapid flow, and consequent spreading. The copy to be imitated is prepared on paper of a yellowish hue, with ink made of Kremnitz *white* mixed with water, and a small quantity of gum Arabic, and placed under the glass."

The pen made use of is constructed in the following manner. "On the inside of a common steel pen is inserted a concave piece of steel having the same curvature with the pen, but not extending as far as its point by about a quarter of an inch. This piece of steel is to be cut off square at the end, and is to be so arranged in the pen as to retain the ink, while it does not interfere with its spring and proper shape; as it is intended that when the point of the pen is pressed upon the glass it shall yield and recede from the aforesaid piece of steel, which retains its original position, and thus the communication is cut off, and the ink is prevented from flowing too fast upon the glass. The surface of the glass must first be prepared for receiving the ink in the following manner. A composition of hard soap and English scouring sand, is formed into a cake of convenient size, and with this the surface of the glass is to be well rubbed; it will then retain the ink."

"What I claim as my invention, is the method of preparing the surface of the glass under which the copy to be imitated is placed, and on which the writing is performed, by rubbing it with a cake composed of hard soap and English scouring sand, as before described."

We are apprehensive that the patentee of the above invention has learned, since obtaining the above patent, that teachers of writing are a very obstinate class of men, preferring the old mode of teaching by pen, ink, and paper, to that by the aid of hard soap and *English* scouring sand.

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8. For an improvement in the *Tub Water Wheel;* Abijah Woodward, Athol, Worcester county, Massachusetts, May 8.

The claim appended to the specification of this patent, will give a sufficiently clear idea of the invention; viz: "What I claim as constituting my invention, is the enlarging of the lower end of the shaft of such a wheel by surrounding the same with a drum; upon which drum I place two rows of buckets in addition to, and in combination with the row of buckets used in the ordinary tub wheel; the whole being constructed and operating substantially as herein set forth."

9. For an improvement in the *Thrashing Machine;* Jesse Lincoln, Uniontown, Fayette county, Pennsylvania, May 8.

This patent is taken for a mode of carrying off the grain and straw from the machine after it has been thrashed, and thus separating them from each other. An endless belt of woven wire passes around a roller at each end of a frame placed immediately in front of that part of the thrasher at which the straw and grain are discharged, and as this endless screen moves around the rollers, it receives a "shaking" motion by the revolutions of what the patentee calls a "flat roller." The claim is to the "combination of the 'flat roller' with the revolving screen, as described."

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10. For an improvement in the *Dredging Machine for Docks, Rivers, &c. &c.;* Oliver Allen, Norwich, New London county, Connecticut, May 8.

This is an improvement on the dredging machine invented by Elisha H. Holmes, for which he received a patent on the 18th of November, 1830, and which is noticed in this journal, vol. vii, page 167. The scoop, as usual, has a handle to it, which passes through a loop in a standard at the side of the boat or scow, and this is drawn forward, in scooping, by a rope or chain attached to a bale, which passes around pullies on the end of two swinging levers projecting from a vertical shaft, and thence around two other pullies to the capstan. A rope is attached to the scoop, where it is connected to the handle, and passes over a pulley at the top of a mast or high standard. By regulating the length of this rope, the point to which the scoop swings back to recommence its operation is also regulated. The patentee says that the "main object of his improvement is so to construct the machine as that the scoop by which the earth is to be raised shall be taken back by its own gravity to any desired point on the bottom of the river, dock, or other water, where the excavating is to be effected, instead of drawing it back by manual labour, as has usually been done." The claim is to the manner in which the scoop is governed and directed by the combined operation of the levers, and the rope or line passing over a pulley on the mast or standard.

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11. For improvements in the *Winnowing Machine;* Abel and Asahel Lomax, Clinton county, Ohio, May 8.

The blower of this fanning instrument is formed with spiral vanes revolving in a cylindrical case open at one end to the atmosphere, the other being adapted to the shoe placed at the end of it. The shoe rocks upon a pivot and journal at the bottom, so that it has greater play at top than at the bottom. The patentees claim, "first the adapting of one end of the cylinder to the shoe, and thus having the air to pass from its end directly into the shoe. And secondly, the mode of arranging the shoe, by which greater motion is communicated to the upper than the lower part of it."

12. For an improvement in the *Garden Hoe;* Charles S. Horner, Boston, Massachusetts, May 8.

The claim appended to this specification explains the nature of the improvement; it is as follows, viz:

"What I claim is the mode herein described, of connecting the hoe plate and shank by forming the latter with a square head and riveting it to the outside of the blade, the shank having been passed through it, and passing an iron collar over the shank on the inside of the hoe plate, in the manner described, so as to confine the plate between said collar and the square head on the outside of it, by means of which arrangement I am enabled to give not only greater strength to the blade of the hoe, but to make the instrument more durable than hitherto constructed."

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13. For improvements in the manner of *Constructing Railroads;* which improvements are applicable to common roads and streets; William Russell, New York city, May 8.

The patentee says, "my invention consists in a new and improved manner of preparing and laying wooden blocks, either on the horse tracks for railroads, or on common roads and streets; and also in a new and improved mode of preparing the string pieces for railways."

"The track upon which horses are to travel upon railroads, and upon which horses and carriages are to pass on common roads and streets, I pave with blocks of wood, but these blocks I form, arrange, and sustain in a new and peculiar manner. Along the road, whether it be a railroad, common road, or street, I lay string pieces in such manner as to form and constitute an abutment on each side of the portion which is to be paved with wood, and these, as well as the wood pavement, I lay upon hemlock or other suitable plank, placed in double thicknesses, crossing each other diagonally, after having first duly graded and prepared the ground for their reception. When a railway is to be formed, I lay plate rails along the string pieces, and these plate rails I confine down by means of bolts and keys." The paving blocks are cut from scantling, diagonally, so that the grain of the wood is inclined instead of standing vertically, and the inside of the string pieces are inclined to correspond with the inclination of the blocks. Two rows of blocks incline one way, and the next two, the opposite way. The claim is to "the manner of forming the track or road, by the combination of the string pieces with sloping sides, and the wooden blocks cut from scantling, adapted to the said sloping sides, and resting on a foundation of boards or plank, as described."

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14. For an improvement in the *Life Preserver;* Ralph Bulkley, New York city, May 8.

Two hollow metallic tubes are attached to a belt, which belt buckles round the body, so as to bring one of the tubes under each arm—a strap attached to the belt passes over each shoulder, and one hangs

down from each side, with a loop at the bottom to answer the purpose of a stirrup, so as to relieve the arms or shoulders of a portion of the weight. The claim is to the "combination of the air-tight tubes with the belt, in the manner, and for the purpose described."

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15. For a mode of *Converting the Matresses of Ships, Boats, &c., into Life Preservers;* Henry Blake Bourne, New York city, May 8. (See specification.)

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16. For an improvement in the *Sparger used in the process of Brewing;* H. Jones Brooke, and Francis B. Longmire, city of Philadelphia, May 8.

The patentees say, "the apparatus or instrument, denominated a sparger, is employed for the purpose of distributing water upon the malt contained in the mashing tub, or tun, in order to extract the saccharine matter in the preparing of the wort. As heretofore made, the sparger has been made to revolve near the surface of the mash tub, by the aid of gearing from a steam engine or other motive power; it has been constructed at considerable expense, and from its complexity has been subject to wear, and get out of order. In our sparger, these difficulties are removed by rendering it self-acting, by causing it to operate upon the principle of 'Barker's mill.'" From the middle of the tub rises a vertical shaft, on which revolves the sparger, which consists of a receiver, or funnel, from which the water runs down two tubes into a receptacle at the bottom, and from this receptacle branch out four hollow arms, with apertures through which the water flows, actuating the apparatus by re-action. The claim is to the manner in which the patentees have combined the re-acting apparatus with the mashing tub, as described.

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17. For a mode of *Stopping leaks in Hose;* Ralph Bulkley, New York city, May 8.

This patent is taken for a mode of stopping breaches in leather hose, whether small or large. Small breaches, or holes, are to be closed by a conical screw plug with a flat head. The point of the screw is to be inserted in the aperture, which, by screwing, is gradually enlarged, embracing the screw until the water is prevented from flowing out. But if the aperture be a slit passing lengthwise, it may be temporarily repaired for use by two corresponding plates of metal, the one to be placed inside of the aperture, and of sufficient length to cover it, there being a corresponding plate upon the outside of the aperture; the two plates are to be drawn together by screws, previously fitted to them, thus firmly binding the edges of the leather between the said plates of metal. If the aperture be so large, or of a description that it cannot be secured by such screws or plates, then a section of metal, or other description of pipe or tube, of suitable dimensions, may be inserted within the defective part, and the apparatus denominated "*breach clogs,*" is to be applied thereto; but if the breach

required to be stopped, be not, in itself, large enough to admit of the application of the "breach clogs," the water hose may be severed by cutting it entirely across, or incisions of suitable extent may be made for the convenient and necessary application of the said apparatus. The claim is to the "mode of repairing lateral breaches in hose by means of screws, as set forth. Also of repairing larger breaches in the same by means of metallic plates and flexible tubes, inserted in hose, constructed and secured in the manner described."

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18. For improvements in the *Fire Escape;* William P. Withey, Hartford, Connecticut, May 12.

The patentee says, "the nature of my invention consists in a system of ladders sliding one within another, with a platform affixed on the top of the uppermost one. The ladders are supported by frame work erected on a circular, revolving base, to which the footing of the ladder is hinged. The ladder is elevated to any angle with the horizon by means of rigging of cord or chains, the whole being supported on an oblong horizontal platform, which is mounted on wheels, to facilitate transportation from place to place." "I do not claim as my invention the ladders, windlasses, pulleys, or any of the above described parts unconnectedly considered—nor do I claim as my invention any of the means by which the several parts are connected together. But what I claim as my invention, and desire to secure by letters patent, is the hinging of the railed platform to the top of the ladder, and rendering it capable of being adjusted to a horizontal position, whatever may be the inclination of the ladder, by means of the toothed segments, the whole being constructed and operating in the manner described."

The segments mentioned in the above claim are attached to the ladder, near the top of its upper section, and pass through holes in the platform, which is hinged to the top of the same section of the ladder; and, by means of pinions on a crank shaft working in standards attached to the said platform, the platform is made to assume any required position.

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19. For an improved machine for *Hulling Grain;* James M'Gregor, Saratoga, New York, May 12.

The first paragraph of the specification gives so clear an idea of the principle of this machine, that we shall merely quote it, together with the claim. "My grain and seed rubbing machine, consists, in general, of a circular disk affixed to a vertical shaft, and made to revolve within a stationary cylindrical case or drum, adapted thereto. Upon each side, and upon the edge of said disk, and upon the interior of each head, and on the rim of the drum, there are placed strips of metal, usually denominated flights, which have such a direction given to them as shall carry the grain from near the centre of the upper side of the disk, where it is fed in, towards its periphery; and then on the under side, from the periphery towards the centre, whence it is delivered; the grain or seed, during its passage, being kept under

pressure by the direction given to the flights, and also by means of a valve borne up against the aperture through which the grain or seed is to escape; a spring or weighted lever being applied thereto."

"What I claim as my invention, and desire to secure by letters patent, in the above described machine, is the manner in which I have combined and arranged the revolving disk, and the hollow drum or cylinder, with flights, or projecting pieces thereon, affixed in such a way as to carry the grain or seed, under considerable pressure, towards the periphery, on the upper side, and towards the centre on the under side of the revolving disk. I also claim in combination therewith, the valve bearing against the delivery opening, for the purpose of increasing the pressure to any desired extent."

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20. For an improvement in the *Franklin Cooking Stove;* J. Houghton, Ogden, Monroe county, New York, May 12.

The jambs, front plate, and top plate with two boiler holes, of the open Franklin cooking stove, are united together, and so arranged that they can be let down so as to bring the boiler holes directly over and near to the fire; for this purpose the jambs slide in holes made in the bottom plate, and a chain attached to the top winds around a shaft passing through the pipe, and having a crank attached to it. The front plate is made with openings like the front of a grate, so that when the front of the stove, top, and jambs, united together, are let down, the front will answer the purpose of the front of a grate. The flues are adapted to this arrangement. The claim is to "making the jambs of the stove, or Franklin, to lower through the apron of the same, so as to bring the boilers that are above the jambs immediately over the fire."

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21. For a machine for *Hulling Rice, Barley, Clover Seed, &c.;* Daniel Tomlinson, Brookfield, Fairfield county, Connecticut, May 12.

This machine consists of a horizontal case, and a cylinder capable of revolving therein. The end of the case which receives the grain is provided with a hopper, and around the opening which communicates with the hopper there are about six oblique wings. Within the case there are teeth arranged in rows; the first three rows of these are about one inch wide, thick in the middle, and tapering towards the edges—they project from the surface about half an inch, and are placed with their flattened surfaces at an angle of forty-five degrees with the longitudinal axis of the cylinder. The rest of the teeth are cylindrical. The opening at the discharging end of the case is provided with a sliding valve to regulate the discharge of the grain. "For most purposes," the patentee says, "the case is perforated with oblong apertures, say half an inch long, and one-twentieth of an inch wide, for the escape of the dust and dirt, but they are not to be so large as to suffer the grain to pass through." The teeth on the cylinder are arranged in the same manner as those within the case, excepting that the rows on the former work between those of the latter, and the cylinder at the receiving end instead of being provided with wings,

has inclined notches, to give free entrance to the grain. The claim is as follows. "What I claim as my invention, and desire to secure by letters patent, is the before described mode of producing any desirable amount of pressure on the materials to be hulled or cleaned, and continuing the same through the whole length of the cylinder, by the combined operation of the oblique teeth, the round teeth, and the sliding gate or issue—effected continually during the operation of the machine."

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22. For a mode of *Fastening Bedsteads;* William H. Sabin, New Milford, Susquehanna county, Pennsylvania, May 12.

This patent is for an improvement on the dovetail fastener, in which a dovetailed projection attached to the post fits into a corresponding recess in the end of the rail.

Dovetailed projections are attached to each post, one for each rail, by means of a ferule, or a segment of a ferule, which is let in and fastened to the post; and the dovetailed recess is made in the end of a ferule fitted to the end of the post. The patentee says, "I do not claim to be the inventor of dovetail fastenings for connecting the posts and rails of bedsteads. But what I do claim, is my improved mode of forming and affixing them by a cylindrical ferule, or segment of a ferule, to the post, and by a ferule to the rails, the end of which ferule is hollowed to adapt it to the post."

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23. For an improved *Sofa for Invalids;* Martin Engel, Borough of Easton, Northampton county, Pennsylvania, May 12.

The arrangement of means by which the sofa can be changed into a chair to recline in any position for the accommodation of an invalid could not be made very clear without drawings, and we will therefore merely state that the bottom of the sofa is made in sections hinged to one another, the middle part being permanent and one end hinged to it so as to be elevated for the back, the upper end of this being made in two parts, is hinged so as to fall back a little for the head. The other end is hinged to the permanent part so as let the legs down, the lower end of this section being so hinged as to make the foot board. The upper section for the back is raised by straps attached to circular arms on the bottom passing over a roller running from front to back under the arm of the sofa, and winding on a windlass below it, and the leg and foot board at the other end is let down and supported by straps winding around a windlass within the other arm piece. The permanent part of the bottom has a hole in it with a cover for the convenience of a patient who is unable to leave the couch.

The patentee says, "having thus fully described the manner in which I construct and arrange the respective parts of my sofa for invalids, and shown the use of those parts respectively, I do declare that I do not claim the so constructing of a sofa, or couch, as that the head and foot parts thereof may be raised or lowered to adapt it to the use of invalids, but what I do claim as constituting my invention.

and desire to secure by letters patent, is the peculiar and novel manner in which these objects are effected by me so as to render it more manageable and convenient than those heretofore constructed. That is to say, I claim the manner in which I have combined the windlass with the rising frame and the jointed arm in the head part, not intending to claim either of those parts separately but only in their entire combination as herein set forth; I in like manner claim the combination of the respective parts which constitute the lowering and elevating portions of the foot end divided into two parts widthwise, and connected and operating as a whole in the manner set forth."

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24. For an improved mode of making and affixing the *Ears and Bails, or Handles, of Pails, Kettles, Buckets, &c.;* John F. Phelps, city of New York, May 12.

The following extract from the specification will be sufficient to convey a clear idea of this improvement, viz: "In the ordinary method of affixing the ears and handles, or bails, of buckets, or other vessels, the ears are made to project above the rims of said buckets, or other vessels, and the wires, or round rods, of which the bails are formed are usually made to hook into said ears with their ends turned outwards. In my improved mode of constructing them the ears are placed entirely below the rim of the vessel and the ends of the bails are turned inwards, and are received and turned round within a concavity formed in the ear or in the vessel for that purpose. These ears may be riveted, screwed, or soldered, to the vessel according to circumstances, they may also be varied in form. What I claim as my invention, and desire to secure by letters patent, is the so constructing and affixing the ears and bails of buckets, or other vessels, of wood, or of metal, as that the hooks of the bails bent inwards shall be received and turn within a cavity prepared to receive them on the under side of the ears as described, the latter being attached so as to stand below the rims of the vessels to which they are affixed. I do not claim the mere turning of the hooks inwards, this having been before done, but I claim only the combination of the hooks and ears as above set forth."

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25. For improvements in *Dry Docks;* John S. Gilbert, city of New York, May 12.

(See specification.)

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26. For a method of *Preventing Explosions in Steam Boilers;* James Reid, Pawtucket, Providence county, Rhode Island, May 19.

The patentee says that "the object of his invention is to prevent the accumulation of the superabundance of caloric in the steam to such a degree as to produce injury or an explosion." And this he effects, or aims to effect, by means of an apparatus connected with the safety valve. A coiled tube closed at top and open at bottom is placed near the top of the boiler, its open end communicates with a

cistern containing mercury, and from near the bottom of this cistern rises a pipe which passes up through the top of it and opens into a tight cylinder provided with a float. The stem of the float is so connected with the lever of the safety valve, and when the float is raised to a certain height it is to open said valve. The tube first mentioned is filled with water, or gas, (the patentee prefers the former,) which is heated by the steam in the upper part of the boiler, thus generating steam in the tube which will press upon the top of the mercury contained in the cistern, and force it to raise up the pipe against the bottom of the float contained in the cylinder, and as this float rises it is to open the safety valve, by its connexion with the lever thereof. The claim is to the coiled tube, mercurial cistern, pipe, cylinder and float, in combination with the safety valve.

The objections which might be urged against the said device are of such a character as, we think, would fully show its inadequacy to the effecting of the object proposed; these we have neither time nor space to urge, nor will they be necessary to those who possess practical, and some scientific, knowledge.

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27. For an improved *Machine for Cleaning Grain;* Samuel Spangler, Stony Creek Township, Somerset county, Pennsylvania, May 19.

A blower similar to that used in the common wheat fan is made use of in this machine, and from the spout thereof arises a vertical trunk, or case, in which revolve three sets of fans or beaters one above the other, worked by bands passing over pullies on their shafts. Two sides of this case are perforated for the escape of dust, and an inclined, perforated plate is placed across the spout of the blower. The grain is fed in through an opening at the top of the case and passes out through an opening at the bottom.

The claim is to the fans in the case, as described, they being arranged one over the other in a perforated case so that they shall act both as beaters and fans in combination with the fan blower.

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28. For improvements in the *Floating Dry Dock;* William Thomas, St. Louis, Missouri, May 19.

This patent is for improvements on the floating dry docks noticed in the fourteenth volume of this Journal, page 232, and in the twenty-second volume, page 239, to the first of which the reader is referred for a description of its general principle, as also to page 336 of volume one, third series. At each end of each float a trunk rises vertically, divided by partitions into a pump well and ballast cistern. Each float is divided into separate chambers by tight bulk heads, and all the chambers are connected with the pump well by means of pipes governed by cocks and valves. The ballast cistern also communicates with the pump well by a valve. The patentee says, "the operation of this dock is by letting water into the pump well at each end of each float, by means of a cock turned by an iron rod which extends to the top of the trunk and from the wells into the several chambers through the several pipes, which pipes are opened and shut by rods

extending to the top of the trunk, and blocks and wooden cocks; and by pumping from the wells to the ballast cisterns the dock gradually sinks to the required depth, to admit the boat, or vessel, to pass free over the blocking, previously arranged to suit her bottom; the water is then shut off; the boat, or vessel, being placed and secured in her proper position, the pumping is commenced and continued until the deck of the dock is raised two or three inches above the water. During the process of sinking or raising the dock, the water is so regulated by letting it into the wells, and from them to the chambers, and by pumping into or discharging from the ballast cisterns, as to preserve an equilibrium at all times.

"What I claim as my invention, and desire to secure by letters patent, is the employment of the ballast cisterns in combination with the floats in the manner described. I also claim the making of the bulk heads which separate the chambers water-tight, so as to prevent the water from passing from one chamber to another except through the pipes governed by cocks as described. I also claim the mode of connecting the several chambers and the wells by means of water and air pipes governed by cocks, valves, or gates, for the purpose and in the manner described."

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29. For an improvement in *Pumps;* Lebbeus Caswell, Harrison, Cumberland county, Maine, May 19.

The alleged improvement consists in making one or more slits in the body of the pump so that the piston rod and the piston can be connected together through said slit or slits, and the piston be worked by a piston rod outside of the pump bore. The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the constructing of one or more slits in the lower part of the tube, or bore, of the pump, and connecting the piston rod with the movable piston by passing it through the same."

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30. For an improvement in *Rifles and other Fire Arms;* James R. Thomas, Collinsworth, Talbot county, Georgia, May 19.

This patent was granted for an improvement on that kind of guns in which a separate chamber, removable from the barrel, is used. The separate chamber is made with a projection around the forward end of the bore, which fits into a recess in the barrel, the breech of the gun being made to receive the said chamber. Near the top of the back end, the chamber is provided with a hole which receives the end of a spring bolt to hold it in place. The spring bolt is drawn back by a projection from the tumbler which acts against an offset on the bolt, so that in bringing the hammer to the half cock the spring bolt is drawn out clear of the hole in the back of the chamber, and on cocking, the projection on the tumbler clears the offset on the bolt, and allows it to return by the action of a spiral spring coiled around it. A part of the lower part of the back of the chamber is beveled off so that in putting in the chamber the beveled part will force back the spring-

bolt until the chamber is in place. When the hammer is at half cock the chamber is forced up out of its place by a pin passing through a hole in the bottom of the case which receives the chamber; this pin is attached to the end of a spring screwed to the under side of the barrel.

The claim is in the following words, viz: "having thus fully described the manner in which I construct the detached chambers and the parts of the rifle, or gun, with which they are immediately connected, what I claim as constituting my invention, and desire to secure by letters patent, is the constructing a detached chamber in the form and manner herein described and represented, and the so constructing the breech of the gun as to receive the same, so that said chamber may be held in place by the projecting end passing into the rear end of the barrel, and by the spring bolt entering the mortise in the back part of said chamber, and so that it will be removed in the act of cocking the gun, or rifle, by the action of the spring and pin, as herein described. I do not make claim to either of these parts taken individually, but I do claim the manner in which I have combined them with each other so as to co-operate together substantially in the manner and for the purposes set forth."

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31. For an improvement in the construction of *Bee Houses;* Robert Martin, Fairfield, Columbiana county, Ohio, May 19.

The improvement claimed in this patent is applied to that kind of bee house in which a number of hives are placed one above the other, and consists simply in making the bottom of each hive of an inclined board which carries all the dirt to the bottom and through a hole in the floor through which it passes to the next hive below, where the same thing takes place until all the dirt is discharged at the bottom hive in the house. The claim is to "the mode of removing the dirt from the top to the bottom of the house by means of the apertures in the floors and drawers combined so as to form a passage from the top to the bottom of the hives."

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32. For an improvement in the *Thrashing Machine;* David Stafford, Syracuse, Onondaga county, New York, May 19.

This improvement consists simply in making the feed board in two parts, and having the part next to the cylinder hinged and borne up by springs so as to yield should any hard substances, such as sticks, or stones, enter the machine. The claim is to "the manner of constructing the feeding table, or drop apron, with one section to drop with the hinge, or pivot, and with the springs or other means underneath to sustain the same, as described; and the object of which is to prevent injury and fracture to the machine."

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33. For a mode of *Applying Water to Propel Mills;* William Baker, Utica, New York, May 19.

The engine employed in this mode of applying water power is similar in construction to the rotary steam engine and pump noticed in

the twenty-sixth volume of this Journal, page 164, to which the reader is referred for a description of it. From the bottom of the case in which the cylindrical segments, against which the water acts, revolve, a hollow trunk, or conductor, descends to the reservoir in which the water is discharged. In applying the water, the conductor and case, in which the segments revolve, are filled with water from the top to the bottom of the reservoir, the whole height not being greater than thirty-two feet, or equal to one atmosphere, and as the segments revolve against air-tight packing, the whole column of water is sustained by the atmospheric pressure, so that there is an atmospheric pressure upon the flanches, or valves, of the revolving cylinders, and by this pressure the segments are actuated. The water is only required to be of sufficient height to cover the segments and keep a constant supply of the fluid. The patentee says, "what I claim as my invention is the method herein described of applying the atmospheric pressure to propel a revolving engine, or machine, by placing a conductor for the passage of the water below such engine, or machine, by the descent of the water in which conductor the pressure of the atmosphere is brought to bear on the engine, or machine, corresponding to the height of the column of water below it. I also claim the combination of the revolving cylinders, and the enclosure in which they are placed, with the conductor below said engine."

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34. For constructing the *Valves, or Boxes, and Chambers of Pumps for Raising Water;* Joseph Evans, Lebanon, Warren county, Ohio, May 25.

The bore of the pump from the seat of the lower box upwards is larger than below, to admit of the introduction and withdrawal of the chamber and its appendages. The lower box consists of a rim and arms connecting it with a hub, or centre piece, provided with a loop by which the whole is removed. The lower part of the rim is tapered and covered with leather so as to fit water tight against that part of the bore on which it rests. The chamber is made of copper, and its inner diameter is equal to the inner diameter of the rim of the lower box, but towards the bottom it swells out so as to receive the box within it, and the two are united by screws. The upper part of the chamber swells out trumpet shaped to fit the bore of the pump where it is provided with a band of leather. The upper box consists of a cylindrical rim united to the centre piece by arms, and it is covered with a circular piece of leather which answers the double purpose of valve and packing—the piston rod screws into the centre piece and embraces the leather valve.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and connected the copper tube, forming the chamber of my pump, with the lower box, or valve, and seat thereof, as described, and for the purpose set forth. I also claim the manner in which I have constructed the upper box, or valve, and seat, that is to say, the causing the

leather disk, which constitutes the valve, not only to operate as a valve but also as a packing to the piston."

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35. For a machine for *Washing Clothes;* Sewall Benson, Waterville, Kennebeck county, Maine, May 25.

The clothes to be washed are attached to a fluted wash board made in two parts, the lower one fixed at the bottom of a frame, and the other sliding in grooves in the side pieces of the said frame, so that after the clothes have been placed over the upper edge of the lower half of the wash board, the upper half is pressed on to them and thus holds them in place. When thus attached, the frame slides up and down vertically between two sets of rollers, the gudgeons of which work in semi-circular arms which are hinged to frame work. One of these frames rests against the side or end of the wash box, and the other has its lower end hinged to the bottom of the box, and its upper end is connected to a weighted lever which presses it against the clothes on the wash board, as they are worked up and down, and the rollers working in the ends of the vibrating semi-circular arms are thus enabled to accommodate themselves to the inequalities which the clothes may present. The frame of the wash board is worked up and down by being suspended to arms projecting from a rocking shaft. The patentee says, "I claim, &c., first, the manner in which I have arranged and combined the rollers on semi-circular arms vibrating on their centres upon vibrating arms, and regulated in their action by a lever borne up by means of a weight. Secondly, the combination of the rollers attached to the semi-circular arms with the vibrating frame and fluted wash boards."

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36. For an improved *Seed Planting Machine;* George Page, Baltimore, Maryland, May 25.

This patent was granted for improvements on that kind of planting machine in which the seeds to be planted are taken from a receptacle by cups attached to a belt passing around two rollers, one of them placed near the bottom of the receptacle, and the other at a suitable height above it; the seeds are put into a hopper, of which the receptacle constitutes a part, but is divided from the main body by means of a sliding shutter, not reaching to its bottom, thus admitting the seeds to pass into the receptacle, but not higher than the bottom of the shutter, thereby preventing their insinuating themselves between the belt and the lower roller. The second improvement consists in attaching to the frame of the machine, a wheel for marking the distance of the rows, this is attached by means of two rods which hook on to the said frame so that it can be reversed at pleasure. The claim is to "the manner of combining the hopper and the receptacle with the sliding shutter, so as to govern the level of the seed in said receptacle, and thus to regulate the feed, in combination with the elevating belt; and also the attaching of a separate marking wheel to the frame of the planter as described."

37. For a mode of making *Metallic Sleigh Runners;* Arunah Spear, Braintree, Orange county, Vermont, May 25.

The patentee says, "the shoe, hub, and raves are connected together by a panel crossing alternately from one side of the runner to the other. This panel is made a little thicker directly under the hub than it is at each end of the runner. The panel and raves so connect the hub and shoe as to form merely, if not quite, a universal brace, in every point liable to exposure or injury. The panel, crossing the runner alternately, places the edges, liable to be broken, at a much greater distance than the mere thickness of the panel, thereby greatly increasing the strength, with but a small increase of weight. What I claim, &c., is the construction of the runners of a sleigh of iron, or other metal, in the manner above set forth, so as to cause the strain, arising from a pressure on one side of the runner, and a pulling on the other, in a manner tending to break the same, to act mainly on the edge of a thin piece of iron, or other metal, thereby avoiding an inconvenient weight, and preventing the centre from operating as a fulcrum over which to break the sides of the runner, rave, or panel."

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38. For a *Life Preserver, or Buoyant Dress;* Rufus Porter, Bellerica, Middlesex county, Massachusetts, May 25.

This dress is made like a pair of pantaloons, with boots, and extending to the arms, with straps passing over the shoulders. A buoyant circle is made around the body of the dress in several separate air-tight chambers, each provided with an inflating tube; and to each leg is attached a set of circular fins, made like a parashute, which open when moving the leg down, and close when moving up. The claim is to "the making the buoyant circle in several separate air-tight chambers, each provided with a tube for inflating, as described; and also the circular fins or paddles, in combination with the water-proof garment."

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39. For an improved mode of *Making the Clasps for Mail Bags;* James Sellers, and Abraham L. Pennock, Philadelphia, Pennsylvania, May 25.

This invention consists in making the clasp of hickory, or other kind of hard, tough wood, instead of forming it of iron, steel, or other metal. A piece of wood is steamed and bent in a mould of the desired shape, and there retained until it becomes set—it is then divided in two parts, longitudinally, is mounted with hinges, &c. &c., and then the leather is secured to it by rivets. The claim is to "the constructing of a clasp composed entirely of wood, and the adapting the same to, and combining it with bags, for the conveyance of letters, traveling bags, or valises, and such others to which it may be adapted; the said clasps being connected together by hinges of metal, by links, or by any flexible material which may be preferred."

40. For an improvement in the *Cooking Stove;* William Jeanes, Philadelphia, Pennsylvania, May 25.

The base of the stove, which is rectangular, is divided into three chambers by two partitions. The box, or body of the stove which contains the oven, is also rectangular, and stands upon the fire cylinder or furnace, which is cylindrical, and upon four columns or pipes, one at each corner. These pipes open below into two chambers, one on each side of the ash drawer, thus making flues leading from one pipe to the other on each side of the stove, and at their upper end these pipes open into the compartments into which the body of the stove is divided. There is also an opening in the bottom plate of the body of the stove communicating with the furnace. Between the bottom plate of the body or box of the stove, and the bottom plate of the oven, there is sufficient space for the flue, and a similar space is left between the top plate of the oven and the top plate of the box. A partition plate passes from end to end of the box or body of the stove, outside the oven, dividing it into front and back chambers; this partition extends from the top plate and down at each end to the bottom plate. Through this partition there is an opening immediately above the oven, which constitutes the only communication between the front and back compartments of the box, excepting through the columns. This opening can be closed at pleasure, by a sliding damper. The end plates of the oven in the back compartments extend down to the bottom plate of the box, so that all direct communication with the flue under the oven, and with the back compartments, is cut off. The smoke pipe on the top plate is placed over that part of the flue above the oven which is behind the partition.

The patentee says, "what I claim is the particular manner in which I have constructed, arranged, and governed the passages for the draught from the fire, as above described. That is to say, the manner in which I have divided the box or body of the stove containing the oven, into two chambers or compartments, by means of the partition, cutting off all communication between said compartments, excepting through the opening in said partition, or through the columns," &c. &c.

Specifications of American Patents.

Specification of a patent for an improved apparatus for taking Daguerreotype Likenesses. Granted to Alexander J. Wolcott, *city of New York, May 8th,* 1840.

To all to whom these presents shall come: Be it known that I, Alexander S. Wolcott, of the city of New York, and State of New York, have invented a new and improved method of taking likenesses from life, of which the following is a full and exact description. At one end of a box a concave reflector (which may either be a piece of solid metal, or of glass silvered,) is placed, with the reflecting surface facing the other end, which has an opening corresponding to the size

of the reflector. In this opening is a light metal frame fixed by a thin support to a piece of wood or other material, with which it slides on the bottom of the box, in a direction perpendicular to the face of the reflector and length of the box; this frame is intended to carry the metallic plate, paper, or other material, on which the impression is to be made—the plate, paper, or other material, may be retained in the proper position against the frame by a small spring, pressing the plate, paper, or other material, on the back, and between which spring and the frame, the plate, paper, or other material, is slid. A small door should be made on the top of the box for the purpose of observing the focal image. The box should be placed on a table, or other support, at such height that the centre of the reflector may be as high as that part of the person which is intended to be in the middle of the picture; when a very small picture of the person is intended to be taken, the focus may be adjusted by a microscope, which may be introduced through a hole in the top or side of the box, or held by the hand, at the door-way on the top. When the camera (that is the box with the reflector,) is to be used, the person whose likeness is to be taken, should be placed in a chair, to which some suitable support for the head is attached, to enable him to remain perfectly still. The camera should then be placed with the open end immediately opposite to the person, a trial plate is then to be placed or put against the frame that stands in the open end of the box, and the focus adjusted by sliding the piece to which it is attached; the trial plate is then to be removed, and the plate, paper, or other material, (prepared in any of the well known methods for being acted on by luminous or other rays,) put into its place, and allowed to remain as long as required, to form the image. A convenient size for such camera would be as follows: the box inside, fifteen inches long, eight and a half inches high, and eight inches wide. Reflector, seven inches clear diameter, and twelve inches focus. The plate, paper, or other material, on which the picture is to be formed, is two and a half inches long by two inches wide.

For taking likenesses for breast pins, the reflector may be about two and a quarter inches diameter, and four inches focus, and all the other parts of the camera of proportionate size. That which I claim as my invention, and desire to secure by letters patent, is the taking of likenesses from life, by the aid of a concave reflector placed so as to receive the rays from the person whose likeness is to be taken, and converge them to a focus, on a prepared plate, paper, or other material placed between the person and the reflector.

ALEXANDER J. WOLCOTT.

***Specification of a patent for an improved mode of converting Matresses into Life Preservers. Granted to* HENRY BLAKE BOURNE, *city of New York, May 8th,* 1840.**

To all whom it may concern: Be it known that I, Henry Blake Bourne, of the city of New York, and State of New York, have invent-

ed a new and useful arrangement, for the purpose of converting the matress, or matresses, of ships, steamboats, and all passage vessels, into a preserver of life and property, and I do hereby declare that the following is a full and exact description. The nature of my invention consists of the peculiar arrangement and adaptation of the common berth matresses now in use, into a life and property preserver. To enable others to make and use my invention, I will proceed to describe its construction and operation; I take a common berth matress (hair or spring,) measuring, generally, some six feet in length, two feet four inches in width, and about six inches in depth, and intersect it in the narrow sides; I then remove the hair, or whatever it is stuffed with, and cover the surface of each open half with common ticking, or any other fabric, forming two separate matresses. I make two water-proof chambers of the length and depth of each half matress, and about one-third or one-quarter of their width, and stuff them with broken cork, or with hair, or whatever occupied the same place before, or with a mixture of hair and cork, and insert one lengthwise into each half matress, against one of its longitudinal edges, replacing the remainder of the stuffing into the other part of each half matress, and sew them up, thus forming two separate matresses stuffed as before, with a part of each water-proof and buoyant. A double-bladed oar is secured on one of the edges of one-half matress, and two shoulder-straps on one of the edges of both half matresses.

I then form a separate water-proof chamber or enclosure, having two sides of corresponding area with the broad surface of the matresses, or less, and I join the upper and lower longitudinal edges by a diamond-shaped slip of water-proof cloth. In the centre of one of the slips is an aperture, with a band around it, and running string, and to the other, two water-proof leggins are attached. There is a slip about two inches wide projecting over the longitudinal edges, circumscribing the two diamond-shaped slips, to which the half matresses, (the water-proof enclosure being laid between them) are buttoned, sewn, or anywise fastened. The operation may be as follows.

When used as a matress to sleep upon, the legs are laid underneath, the oar and straps lying against either side of the berth, and it then differs in no respect from those in present use; but on an emergency, the tenant of the berth thus provided, takes the article out, places in the water-proof enclosure through the aperture, whatever valuables he may desire, or have time to preserve, papers, monies, clothes, and provisions for many days; he then puts his feet into the leggins, draws the string around the aperture close round his chest, and by placing his arms under the shoulder straps, he is enabled by the leggins to go on deck and jump overboard—when in the water, he can use the oar attached to navigate with; the depth of the matresses will protect his vitals, and, when on shore, the leggins again enable him to retreat beyond the reach of the returning wave. The article, if preserved, will answer as such again, being capable of all necessary repairs.

What I claim as my invention. and desire to secure by letters patent, is the method of adapting the common berth matresses to a life and property preserver, by making a water-tight chamber, pro-

vided with leggins between the two halves of the matresses, for the purpose, and in the manner described. I also claim the making a portion of each half of the matresses buoyant, for the purpose, and in the manner described.

HENRY BLAKE BOURNE.

Specification of a patent for an improved mode of constructing Dry Docks. Granted to JOHN S. GILBERT, *city of New York, May 12th*, 1840.

To all to whom these presents shall come, be it known that I, John S. Gilbert, of the city of New York, in the county and State of New York, Engineer, have invented certain new and useful improvements in the construction of dry docks, to be of wood or of sheet iron, the bottom to be strengthened with timbers, which I term clamps and buttresses. Also a water stopper for preventing leakage at the entrance gates, which I term a hydrostatic water stopper, of which improvements the following is a full and exact description.

The buttresses are timbers bolted one upon the top of another, starting on the upper clamps (to which they are fastened,) far within a plumb line dropped from the side of the largest ships, for which the dock is intended, thence running up on such angle as shall leave breadth opposite the bilge of the ship (when she sets on the blocks,) sufficient to enable the workmen to stand upon them and caulk, or otherwise repair, the bottom of the ship. As a general rule, I divide the width of the dock into three equal parts, the lower edge of the buttresses extend across one-third of the bottom on each side, and thence run upon such angle as shall intersect with the upper edge of the perpendicular sides of the dock. By this mode of construction, only one-third of the transverse section of my dock is left unsupported, (except by the timber under the keel.) This method, I have reason to suppose, is an improvement on the usual method of building floating docks, inasmuch as I can build my dock wider, and yet leave less width of bottom unsupported; by means of this increased width I obtain a greater degree of light at the keel of the ship, and likewise a greater degree of steadiness, and when the inner or slanting sides of these buttresses are planked up, if such should be deemed advisable, it will form a dock that will retain less water after the ship is floated in, than any other form, shape, or construction.

The bottom and buttresses thus combined, form as near as may be, an inverted arch to the buttresses. Shores are attached, with joints to allow of their being made to rest against the dock frame or sides of the ship, thereby forming, as near as may be, an opposite arch to that formed by the bottom and buttresses. It will be seen, upon examination, that no brace work, or other mechanical contrivance, can offer so perfect a resistance to the upward and lateral pressure of the water as these solid dead woods, as they depend entirely upon their own strength.

The advantage which I derive from this my method of construct-

ing and strengthening the bottom of my dock are various, amongst the most important is that of being able to operate with it in shoal water; for, as the quantity of timber required to be laid crosswise to give to the bottom of the dock sufficient strength to sustain the weight of the class of ships for which it is intended, must depend mainly upon the length of said cross timbers between supporters; it will be seen at once that my plan of letting the buttresses extend from the sides of the dock at least one-third across the bottom on each side, shortens that part which cannot be strengthened but by an increase of timber placed under the keel, and consequently I am enabled to set the keel of the ship much lower than by any other mode of construction. No allowance need be made for the lower clamps, in calculating the depth of water to operate in, as they will settle into the mud.

Another advantage of my plan is, that I have dispensed with all water-tight chambers below the keel, in the middle of the dock, the workmen can therefore stand upon the lowest point in the dock, and as a part of the cross timbers are below, or on the under side of the bottom, they can easily step over the upper clamps, which would be difficult if they were all on top. Another and still greater advantage to be derived from this, my plan, is the perfect security against leakage. The usual method of constructing single bottom docks, as well as ships and other floating vessels, is to fasten the planks on the under side of all the floor timbers, the caulked joints are thereby brought (especially in the case of docks,) on the outer line of the circle given to the bottom of the dock by the weight of the ship resting on the centre blocks, it has been found impossible to keep the bottom joints from opening and shutting.

The method by which I fasten my dock together is to bolt the bottom on to the lower clamps, and caulk it on the upper side, the upper clamps are then placed directly over them, and are bolted through and through. Supposing the upper clamps to contract as much as the lower ones expand, there will be no important effect produced upon the caulked joints. But in addition to all the advantages to be derived from this my method, as above set forth, I am enabled by the use of the upper and lower clamps, to build my dock in the water, instead of the usual and expensive method of building on the land, and I thereby save the trouble and danger of launching. The buoyancy of the lower clamps may be increased if it is not sufficient, by other buoyants, until the fore and aft timbers that form the tight bottom are fastened and caulked; the streaks and layers of timbers that form the sides are caulked as they are laid up, so that the joint to be caulked is always above water. The hydrostatic stopper is a leathern hose, or hose of other flexible water-tight substance, placed in a groove, of half a circle, more or less, cut into the frame, made of the shape of the entrance of the dock, or other parts of the dock, where its use may be required as a water stopper, so that the frame may be removed, if necessary, in order to repair the hose. The manner in which I apply the said water stopper is to fill it after the entrance gates are closed, with water or other liquid, so that an outer

pressure is produced sufficient to stop the water from passing between the hose and gate. When the dock is to be filled with water, in order to float out the ship, the liquid is drawn off through a faucet.

Having thus fully described the manner in which I construct the bottom and buttresses of my dock, and also the mode of using my hydrostatic water stopper, I do hereby declare that what I claim therein as my own invention, and desire to secure by letters patent, is, first, the particular manner of arranging the cross timbers by placing a part below, and a part above, the caulked bottom, thereby securing said caulked bottom between clamps, for the purpose of preventing the opening and shutting of said caulked seams, &c. Second, the employment of a hydrostatic water stopper, for the purpose, and in the manner heretofore described in this specification. In testimony whereof, I, the said John S. Gilbert, hereunto subscribe my name in the presence of the witnesses whose names are hereto subscribed, on the 22nd day of April, A. D., 1840.

JOHN S. GILBERT.

Application of the process of Gilding in the moist way, to the Art of Engraving.

(Extract of a Letter from Professor DELA RIVE to M. DUMAS.)

Mr. Hamman, an engraver of our city, (Geneva,) has just made an interesting application of my process of gilding, to the art of engraving, by aquafortis. He gilds the plate of copper designed to receive the engraving, instead of covering it with wax, and then traces upon its surface the lines of his design, removing the gold wherever the point passes. He then spreads over it the aquafortis, which attacks and corrodes the copper wherever it is exposed. This process seems to have several advantages over that in which wax is employed. In the first place, the coating of gold being permanent, the plate may be corrected if the proofs show faults; in the other process, when the wax is removed, it is very difficult to make any corrections. Moreover, the lines which are traced upon the coating of gold may be made much more fine and delicate than those which we find upon wax. It appears that gilding by mercury, besides being much more expensive, does not present the same advantages and facilities in application.

Annales de Chemie et de Physique.

LUNAR OCCULTATIONS FOR PHILADELPHIA, AUGUST, 1841.

COMPUTED BY JOHN DOWNES.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.

☞For direct vision add 180°.☜

Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	15	59	Im. 19 Capricorni, Em.	6 *invisible.*	99°	41°
19	7	32	Im. *q* Virginis, Em.	5.6 *invisible.*	99	147

Meteorological Observations for May, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	46	54	29.35	29.35	W.	Brisk.		Cloudy—flying clouds.
	2	44	50	.64	.45	W.	do.	.06	Cloudy—shower—hail.
	3	31	48	.76	.80	W.	do.		Clear—frost—cloudy.
	4	34	50	.84	.86	W.	do.		Clear—do
☉	5	33	56	.80	.80	W.S.	Moderate.	.33	Clear—white frost—rain.
	6	42	58	.75	.80	W.	Brisk.		Clear—flying clouds.
	7	40	52	30.10	30.00	NW.	Moderate.		Clear—cloudy.
	8	44	57	29.80	29 90	NE.	do.	.65	Rain—cloudy.
	9	45	70	30.10	30.08	W.	do.		Clear—hazy.
	10	50	59	29.80	29 55	E.	do.	.45	Rain—do.
	11	51	65	.40	.40	W.	Brisk.		Clear—flying clouds.
	12	54	64	.43	.43	W.	Calm.	.14	Cloudy—showery.
☽	13	45	64	.65	.65	W.	Moderate.	.13	Clear—shower.
	14	41	62	.70	.73	W.	do.	.07	Clear—shower.
	15	42	64	.85	.90	W	do.		Clear—flying clouds.
	16	42	64	.96	.96	E. SW.	do.		Clear—flying clouds.
	17	52	64	.85	.60	W.	Brisk.	.01	Cloudy—shower.
	18	46	66	.75	.76	W.	do.		Clear—flying clouds.
	19	46	66	.80	.81	W.	Moderate.		Partially cloudy—do. do.
⊗	20	41	71	.94	30.09	W.	do.		Partially cloudy—clear.
	21	48	78	30.00	.00	SW.	do.		Clear—do
	22	57	86	29.95	.00	W. SW.	do.		Hazy—do.
	23	65	83	.96	.00	SW.	do.		Cloudy—clear.
	24	62	84	30.00	.00	SW.	do.		Partially cloudy—clear.
	25	62	84	.01	29 99	SW	Brisk.	.43	Clear—thunder shower.
	26	64	73	29.90	.90	SW.	Moderate.	.53	Cloudy—rain—cloudy.
☾	27	63	70	.90	.95	SE.	do.	.13	Cloudy—rain.
	28	64	81	.95	.98	S.	do.		Fog—flying clouds.
	29	66	80	.95	.93	W.	do.	.02	Drizzle—partially cloudy.
	30	60	70	.90	.96	E.	do.	.05	Drizzle—cloudy.
	31	50	73	30.00	.93	E.	do.		Clear—do.
	Mean	49.52	66.68	29.83	29.83			3.010	

	Thermometer.		Barometer.	
Maximum height during the month,	86.00	on the 27th.	30.10	on the 7th and 9th.
Minimum " "	31.00	" 3rd.	29.35	" 1st.
Mean	58.10		29.83	

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

JULY, 1841.

	County.	Town.	Observer.	Thermometer. 7, A.M.	2, P.M.	9, P.M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	7, A.M.	2, P.M.
1	Philadelphia,	Philadelphia,	E. W. Hamilton,	72.15	82.63	73.58	97.00	60.50	76.12	5	53.00	63.24	2	30.02	29.99
2	Montgomery,														
3	Bucks,	Newtown,	L. H. Parsons,	68.30	77.84	66.29	90.50	57.00	70.81	1/3	50.00	60.27	1	30.03	30.00
4	Lehigh,														
5	Northampton,														
6	Monroe	Stroudsburg,	A. M. Stokes,	67.73	84.83	69.00	94.00	50.00	73.89	12 1/3	.....	.....	.	29.61	29.63
7	Pike,														
8	Wayne,														
9	Susquehanna,	Silver Lake,	E. Rose,	66.22	80.00	72.25	93.00	57.00	72.82	.	57.00	63.22	.	28.13	28.14
10	Luzerne,														
11	Schuylkill,	Port Carbon	P. C. Lyceum,	65.39	86.67	63.77	100.00	52.00	71.94	2 1/3	36.00	47.80	6	29.33	29.35
12	Berks,														
13	Chester,														
14	Delaware,	Haverford,	Haverford School,	72.13	77.10	74.35	87.50	62.00	74.52	1/3	61.00	60.03	1	29.49	29.45
15	Lancaster,	Lancaster,	Conservatory of Arts,	68.74	82.26	76.37	92.50	60.00	75.79	.	55.00	65.61	.	29.54	29.53
16	York,														
17	Lebanon,														
18	Dauphin,	Harrisburg,	J. Heisely,	72.53	81.90	77.13	91.00	65.00	77.19	1	59.00	69.06	.	29.74	29.69
19	Northumberland,	Northumberland,	Andrew C. Huston,	70.00	78.00	72.32	91.00	64.00	73.44	.	47.00	61.19	.	29.53	29.51
20	Columbia,														
21	Bradford,														
22	Tioga,														
23	Lycoming,														
24	Union,														
25	Mifflin,														
26	Juniata,	Mifflintown,	J. A. Kinkead,	61.52	80.18	68.31	92.00	48.00	70.00	3 2/3	.....	.....	.	29.49	29.45
27	Perry,														
28	Cumberland,														
29	Adams,	Gettysburg,	Prof. M. Jacobs,	68.48	83.02	70.47	93.00	61.00	73.99	.	54.00	62.10	.	29.41	29.41
30	Franklin,														
31	Huntingdon,	Huntingdon,	Prof. Jacob Miller,	68.16	86.40	70.03	98.00	56.00	74.86	2	.....	.....	.	29.42	29.40
32	Centre,	Bellefonte,	John Harris,	66.21	83.96	71.00	95.00	52.00	78.72	10 1/3	.....	.....	.	29.31	29.28
33	Potter,														
34	M'Kean,	Smithport,	M. R. Atkins,	60.19	76.61	65.16	90.00	49.00	67.32	.	41.00	53.35	.	.....	.....
35	Clearfield,														
36	Cambria,	Ebensburgh,	Richard Lewis,	62.30	80.00	63.29	96.00	47.00	68.53	1 2/3	42.00	55.77	1	28.00	28.00
37	Bedford,	Bedford,	Samuel Brown,	67.16	82.89	70.85	95.00	54.50	73.63	2/3	.....	.....	.	29.27	29.27
38	Somerset,	Somerset,	George Mowry,	64.93	76.29	63.92	85.00	54.00	68.38	6 2/3	45.00	57.10	2	27.91	27.93
39	Indiana,	Indiana,	Richard White,	75.39	84.39	66.39	98.00	50.00	75.39	.	40.00	53.35	5	28.80	28.80
40	Jefferson,														
41	Warren,														
42	Venango,	Franklin,	Wm. Connely,	65.46	79.05	72.78	90.00	54.00	72.43	8	.....	.....	.	29.02	29.01
43	Armstrong,														
44	Westmoreland,														
45	Fayette,	Uniontown,	J. P. Weethee,	68.77	84.39	68.58	96.00	55.00	73.91	.	.....	.....	.	29.07	29.07
46	Green,														
47	Washington,														
48	Alleghany,	Pittsburgh,	J. P. Bakewell,	72.11	77.31	74.83	98.00	61.00	74.75	2 1/3	50.00	62.97	1	29.30	29.27
49	Beaver,	Beaver,	James Allison,	69.74	83.73	68.27	95.00	59.00	73.91	1/3	48.00	59.39	.	29.47	29.42
50	Butler,	Butler,	Jacob Mechling,	65.90	79.81	72.21	91.00	56.00	72.64	.	.....	.....	.	28.88	28.89
51	Mercer,														
52	Crawford,	Meadville,	Henry Shippen,	70.13	75.84	72.61	86.00	62.00	72.86	.	46.00	56.68	.	28.74	28.72
53	Erie,	Erie,	James C. Reid,	67.29	74.10	68.71	86.00	57.00	70.03	2/3	.....	...	..	29.46	29.46

Register.			Barometer.							Weather.								North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.
	Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.								
0	63.24	2	30.02	29.99	30.01	30.36	29.59	30.01	3½	19⅔	7	4	2	.....	.....	4	3.228	2⅔	1⅔	1	·	⅛	·	⅛	
0	60.27	1	30.03	30.00	30.00	30.37	29.78	30.01	⅓	17⅓	12	1⅔	7	.....	.....	3	4.400	·	⅓	2⅓	·	·	·	2	
..	.....	.	29.61	29.63	29.57	29.98	29.40	29.60	9⅔	14⅓	5⅓	11⅓	4	.....	.....	1	5.250	1⅓	·	1⅓	·	⅔	·	⅔	
0	63.22	.	28.13	28.14	28.13	28.33	27.83	28.13	·	17⅓	13⅔	·	7	.....	.....	..	2.070	2	·	·	·	·	·	·	
0	47.80	6	29.33	29.35	29.32	29.63	29.13	29.33	2⅓	21⅔	7	2⅓	3	.....	.....	3	3.657	⅛	·	⅓	·	1⅔	·	1	
0	60.03	1	29.49	29.45	29.46	29.84	29.23	29.47	⅓	20	10⅔	⅓	4	.....	.....	..	1.975	3⅔	⅔	·	1	⅛	·	·	
0	65.61	.	29.54	29.53	29.54	29.85	29.27	29.54	.	21	10	·	5	.....	.....	2	1.430	3	1	1⅔	⅛	⅛	⅛	1	
0	69.06	.	29.74	29.69	29.71	30.01	29.51	29.71	.	.	.	·	1	.....	.....	5	2.046	2⅔	·	·	·	·	·	1	
0	61.19	.	29.53	29.51	29.51	29.84	29.29	29.52	.	11⅔	19⅓	·	7	.....	.....	4	2.546	5⅔	⅓	2	·	⅔	·	3⅔	
..	.....	.	29.49	29.45	29.46	29.80	29.25	29.47	4	18⅔	8⅔	3⅔	1	.....	.....	4	1.180	·	·	⅛	·	⅜	·	2	
0	62.10	.	29.41	29.41	29.40	29.69	29.17	29.40	·	22⅓	8⅔	·	7	...	.....	..	2.620	4	·	1⅛	·	·	·	⅔	
.	.....	.	29.42	29.40	29.39	29.68	29.18	29.40	2	25	6	·	7	.....	.....	..	0.976	·	·	·	·	6⅔	·	·	
.	.....	.	29.31	29.28	29.27	29.59	29.07	29.29	11⅓	12	5⅔	13⅓	2	.....	.....	1	4.740	1⅓	·	1⅓	·	·	·	⅛	
0	53.35	.	.....	.....	.....	.....	.....	.....	·	23⅔	7⅓	·	5	.....	.....	4	2.260	⅛	·	1⅔	·	1⅓	·	1⅓	
0	55.77	1	28.00	28.00	28.00	28.27	27.76	28.00	1⅔	11⅓	17	2⅓	2	.....	.....	5	2.857	1⅔	·	·	·	·	·	1⅓	
..	.....	.	29.27	29.27	29.25	29.55	29.03	29.27	⅔	18	12⅓	⅔	.....	.....	.....	..	.....	·	·	·	·	·	1⅛	·	
0	57.10	2	27.91	27.93	27.93	28.12	27.70	27.92	6⅔	10⅔	13⅔	6⅔	3	.....	.....	3	2.431	⅓	·	⅛	·	·	·	⅛	
0	53.35	5	28.80	28.80	28.80	29.10	28.50	28.80	.	22⅔	8⅓	·	6	.....	.....	..	2.040	·	·	·	·	·	·	⅛	
.	.....	.	29.02	29.01	28.98	29.30	28.78	29.00	8⅓	·	·	·	.....	.....	.....	..	.....	·	·	·	·	·	·	1	
.	.....	.	29.07	29.07	29.07	29.24	28.60	29.07	·	26	4⅔	⅓	.....	.....	.....	..	.....	1	·	1⅓	·	·	·	1	
0	62.97	1	29.30	29.27	29.27	29.48	29.04	29.28	2⅓	13⅔	15⅓	2	3	.....	.....	3	3.456	·	·	⅜	⅛	·	·	1⅓	
0	59.39	.	29.47	29.42	29.39	29.66	29.00	29.43	⅔	17⅔	12⅓	1	4	.....	.....	1	1.280	·	·	⅛	·	·	·	2	
.	.....	.	28.88	28.89	28.89	29.10	28.65	28.89	·	·	·	·	.....	.....	.....	3	1.578	·	·	⅛	·	7⅔	·	·	
0	56.68	.	28.74	28.72	28.73	29.01	28.55	28.73	·	18	12	1	10	.....	.....	1	3.430	4	·	1⅔	·	5	·	⅓	
..	....	.	29.46	29.46	29.43	29.70	29.20	29.45	⅓	23	7⅔	⅓	8	.....	.....	..	4.312	3	2⅓	5	·	·	·	⅛	

Winds.														Hygrometer.					
East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
	.			4	3	5		2		4	1	.	3	....	.	.....	....	..	1545
.	.	12		1	.	12		1	.	8	.	.	2	....	.	.....	....	..	1537
	.			1	.	6	.	6	.	2	.	.	9	....	.	.....	....	..	1545
.	.	.	.	2	.	6	.	12	.	8	.	.	.	....	.	.....	....	..	1576
1	.	1	.	.	.	2	.	6	.	1	.	15	2	....	.	.....	....	..	1548
	.	.	.		1	6	1	2	1		.	1	10	59.50	1	.....	71.00	1	1553
		1		3	1	4	2	3	1	3	2	.	.	59.52	.	.....	68.19	.	1554
.	.	1	.		.	8	.	13	.	4	.	.	1	....	.	.....	....	..	1536
	.	3		6	.	1	.	4	.	2	.	3		....	.	.....	71.00	..	1541
	.	2	.	.	.	2	.	1	.	3	.	17	4	....	.	.....	....	..	1540
.	.		1	5	2	4	1	1		1	1	5	.	59.75	16	.....	66.25	16	1560
6	.	.	.	.	.	.	.	22	.	.	.	.	2	....	.	.....	....	..	1557
.	.			1	.	2	1	2		1		1	16	....	.	.....	....	..	1551
1	.	1	.	1		4		14	.	4		.	1	....	.	.....	....	..	1555
.	.	1	.	1	.	6	.	9		5	.	3	3	....	.	.....	....	..	1549
.	1	.	.		.	5	5		12	5	.	.		....	.	.. .	....	..	1539
.	.			1	.	5	.	17	.	.	.	7	.	....	.	.....	75.07	11	1543
.	.	1	.	.	.	1	.	5	.	20	.	.	8	....	.	.....	....	..	1636
.	.	1	.		.	9	.	6	.	5	.	5	.	....	.	.....	....	..	1556
.	.	1	.	.	.	2	.	2		7		7	2	....	.	.....	....	..	1606
.	.	2	.	.		3	.	1	.	16	.	6	1	....	.	.....	....	..	1552
7	.	.	.		.	3	.	18	.	1	.	.	.	....	.	.....	....	..	1589
5	.		.	3	.		.	1	.	1	.	14	1	....	.	.....	....	..	1544
.	.		.	1	.	4	1	7			1	3	.	....	.	.....	....	..	1542
																			1680